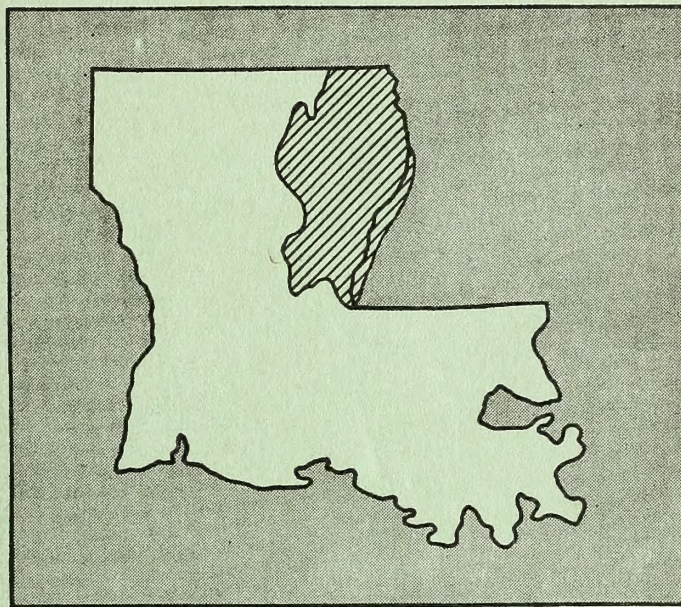


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FOREST RESOURCES *of the* North Louisiana Delta



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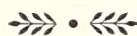
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Forest Resources of the North-Louisiana Delta



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SOUTHERN FOREST EXPERIMENT STATION

FOREST SERVICE



Computations in charge of

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The Forest Survey

EFFECTIVE rehabilitation and constructive management of this country's forest resource requires not only protection against neglect and destruction but, with equal urgency, provision for permanent and wise use of that resource. Wisdom in forest land-use planning must rest on a long-time economy backed up by reliable facts as to supply and requirements for wood and other forest products, production and consumption, drain and growth, and the location, area, and condition of existing and prospective forest lands. This requirement for dependable and comprehensive technical information is now being translated into action through the provisions of the McSweeney-McNary Forest Research Act of May 22, 1928, authorizing a Nation-wide forest survey.

The Forest Survey, as constituted under that act, is obtaining essential field information and, through interpretation thereof, is aiding in the formulation of guiding principles and policies, fundamental to a system of planned management and land use for each forest region and for the Nation.

The fivefold purpose of the Forest Survey is: (1) To make a field inventory of the present supply of timber and other forest products; (2) to ascertain the rate at which this supply is being increased through growth; (3) to determine the rate at which it is being diminished through industrial and domestic uses, windfall, fire, disease, and other causes; (4) to determine the present consumption and the probable future trend in requirements for timber and other forest products; and (5) to interpret and correlate these findings with existing and anticipated economic conditions as an aid in the formulation of both private and public policies for the effective and rational use of land suitable for forest production.

It is planned to publish the results of this investigation as they become available. These publications apply to large areas and should not be interpreted as portraying correctly the forest situation for small sections, the condition of which may be either better or poorer than the average for the entire unit. They supply the general framework upon which to base intensive studies of critical situations.

The investigation is conducted in the various forest regions by the forest experiment stations of the Forest Service and in the South by the Southern Forest Experiment Station, with headquarters in New Orleans, La.

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Introduction

THE north-Louisiana delta contains one of the most valuable supplies of high-quality, old-growth hardwood timber left in the United States. Here the old-time sawmills cutting industrial hardwood lumber still abound. In many other parts of the South the original lumber mills have cut out the most readily available timber, have been accordingly abandoned, and have subsequently been replaced by small, portable mills. The forest-economic problem of this survey unit is to prolong the period of operation of these mills cutting old-growth timber until the present second-growth forest becomes merchantable. This report presents facts bearing upon the forest situation, analyzes and interprets these facts, and offers suggestions which should aid in solving the principal forest problems.

The report is based on a field survey made chiefly between November 1933 and February 1934. Trained crews of experienced timber estimators recorded the conditions on 4,563 quarter-acre plots distributed at 660-foot intervals along compass lines 10 miles apart running east and west. On forest plots trees were measured with calipers; growth rates were determined by means of increment borings; and all other data needed to determine stand volume and quality and to predict timber

growth were gathered and recorded. Using these recorded data as a statistical sample representing the entire area, the average and total figures were computed. Statistical analyses of Forest Survey results indicate that the maximum error of the estimate of the total forest area is less than 3 percent and of the total timber volume less than 4 percent. For relatively small items of area or volume the error may be considerably larger, and for very small items the figures should be regarded as merely indicative of the relative importance of the item.

Data on forest industries and forest drain for the calendar year 1934 were obtained by a canvass of forest-products enterprises and domestic wood users, and through summarized lumber-production statistics previously compiled by several divisions of the Lumber Code Authority of the National Recovery Administration. Present consumption and probable future trends in national requirements for timber and other forest products are being studied on a Nation-wide basis and will be treated in a separate report.

Because of the large quantity of data presented in the following pages, it will be of advantage to summarize here some of the more significant data and findings.

Summary of Findings

THE GENERAL SITUATION

THE land area of the north-Louisiana delta unit¹ is 3,897,000 acres, of which approximately 69 percent is forest land, 29 percent agricultural land, and 2 percent in other uses.

The forest area of 2,682,700 acres supports a stand of practically pure hardwood timber. Approximately 22 percent bears uncut old growth, 26 percent partly cut old growth much of which is at present noncommercial, 31 percent sawlog-size second growth, and 18 percent under sawlog size second growth and reproduction. Only 3 percent is clear-cut and nonproductive.

The total saw-timber volume in trees 13 inches and over d. b. h.² is 10 billion board feet, according to the International $\frac{1}{4}$ -inch log rule, which closely approximates green-lumber tally. Of this volume, it is estimated that about 20 percent is of the species, quality, and stand per acre that are generally attractive to commercial operators cutting industrial lumber, cooperage stock, and veneer. Although the remainder is now commercially useful only for low-grade lumber such as structural material and cross ties, it represents a tremendous potential resource, pending economic developments and changes in manufacturing and marketing practices. In addition to the 10 billion board feet in good trees, it is estimated that there are between $2\frac{1}{2}$ and 3 billion board feet gross scale in trees that are culled on account of rot, poor form, or other defect. The total cubic volume, not including top wood, in

good trees is 2,360 million cubic feet in trees 5 inches and over d. b. h.

The 1934 increment of the forest-growing stock was approximately 210 million board feet in sawlog-size material, or, including the stems of all good trees above 5 inches diameter at breast height, 45 million cubic feet excluding bark. It is estimated that about 30 percent of the board-foot increment is of species, quality, and stand per acre that are suitable for utilization in the manufacture of industrial lumber, cooperage stock, and veneer.

The total volume removed from the forest in 1934 (in trees more than 13 inches d. b. h.) exclusive of natural mortality was 321 million board feet, or 52 million cubic feet, with all good trees 5 inches and over in diameter included. It is estimated that nearly 70 percent of the board-foot drain is of species, quality, and stand per acre that are suitable for utilization in the manufacture of industrial lumber, cooperage stock, and veneer. The remainder comes from stands of lower quality and goes largely into fuel wood, railroad cross ties, and structural material.

Comparison of the board-foot increment with the total board-foot timber drain shows that the drain exceeded the increment by nearly 111 million board feet in 1934. The drain from stem wood of all good trees 5 inches and larger in diameter was 7 million cubic feet more than the corresponding increment.

In 1934 logging operations and the manufacture of logs into lumber, veneer, cooperage stock, and similar primary forest products supplied employment to approximately 3,750 full-time workers.

ANALYSIS

Excluding the 577,600 acres of uncut, old-growth timberland, the forest area is characterized by

¹ A forest survey unit is an area of 2 to 10 million acres in which forest, economic, and industrial conditions are reasonably homogeneous. The division of a State in this manner facilitates analysis and discussion of the forest situation.

² D. b. h. = diameter breast high, i. e., $4\frac{1}{2}$ feet from the ground.

second-growth stands and recently cut-over stands containing a large proportion of cull trees and residual trees of inferior quality or species. These trees of little worth at present are also in many cases slow-growing and take up growing space that might be occupied more profitably by young, rapidly growing crop trees.

The supply of timber of quality, species, and stand per acre now actually being utilized in the manufacture of industrial lumber, veneer, and cooperage stock constitutes 20 to 25 percent of the total standing saw-timber volume, and it is being cut probably between three and four times as fast as it is being grown.

The board-foot volume of material unsuited, according to present practices, for the manufacture of high-grade commodities is now increasing about twice as rapidly as it is being used, and the rate of increase undoubtedly will be accelerated in the future. This accretion of saw timber unsuitable for present use by forest industries requiring high-quality timber is building up a reserve resource of steadily improving quality to supply the forest industries of the future.

To utilize this resource fully, wood-using industries must in the future adapt their requirements for raw material to a smaller proportion of high-quality timber, and must develop a larger market (1) for species not generally used at present, (2) for lower grades of lumber (probably as small dimension and structural material), (3) for lower grades of cooperage stock, (4) for box and crate material including package veneer, and (5) for round material in such products as pulpwood, chemical wood, and posts.

Therefore, the major forestry problem of this unit is twofold: (1) To bring the timber growth (particularly of high-quality timber) and timber drain into balance at a level of production commensurate with the productive ability of the area, and (2) to develop markets and manufacturing methods that will permit the utilization of timber of low quality and of species not now being fully utilized.

CONCLUSIONS

The solution of this forestry problem involves:

1. The improvement in conditions affecting forest growth through removal of suppressed trees from crowded young stands, and of cull trees and trees of inferior quality from all stands. This can

be accomplished, in part, by a change in the practices used in cutting wood for farm and other domestic use. It is estimated that more than half of the total timber cut at present for domestic use is taken from immature trees that otherwise would develop into an industrial resource. Farm fuel wood, fence posts, and similar material should, therefore, be taken from low-quality residual trees, from cull timber, and from thinnings.

2. The improvement in silvicultural conditions through protection of the forest from fire. Despite popular belief to the contrary, forest fires substantially reduce the volume of high-quality industrial hardwood timber and the productivity of hardwood forests. To reduce fire losses, Federal and State cooperation in forest-fire prevention and control should be extended to this unit.

3. The conservation of the present resources of high-quality timber through (a) partial cuttings which remove, at a relatively low unit logging cost, the large, ripe, or mature timber and leave a substantial growing stock of thrifty high-quality second-growth trees mostly under 30 inches in diameter and (b) full and most economic use of the trees cut, by converting all logs into the product for which they are best suited.

4. An adequate program of forest research. Studies to determine rates of hardwood timber growth, the best systems of hardwood forest management, and improved methods of logging, should be initiated without delay. Demonstration areas should be established where the results of these improved practices can be illustrated. Forest-products research should be expanded as the first step in developing markets for timber not commonly used because of species or quality.

5. A program of forestry education. There is a definite need for forestry extension work among the hardwood timber operators and timberland owners to promote an understanding of the opportunities as well as the methods of forest management for timber growth. This work can well be undertaken by the foresters of lumber associations and other trade associations and by consulting foresters, as well as by State and Federal forestry organizations.

6. The reduction and stabilization of forest-land taxes.

7. State and Federal forest ownership, where private forestry practice cannot be expected to succeed. Large-scale private timber growing is most

likely to fail on the so-called "backwater areas" supporting stands of overcup oak and pecan, where timber-growth rates are slow and timber quality low. The only incentive to private ownership of these lands for forest purposes is the prospect of early liquidation through cutting of the old-growth timber. When once stripped of their original stands, lands in these heavily inundated areas will revert eventually to State ownership for nonpayment of taxes unless oil or some other subsurface resource is discovered. Forest management on these lands will become, therefore, either a State or national problem.

8. Cheap, long-term financing. Some form of cheap, long-term financing is necessary in order to stabilize forest ownership, to facilitate continuity of management policy, to assist private owners of timberland during the early stages of building up to a sustained yield, and to encourage the continued investment in growing stock thereafter. The extension to forest owners of credit facilities, such as those now afforded by the Reconstruction Finance Corporation to industrialists and by the Farm Credit Administration to farmers, is suggested.

General Description of the Unit

THE north-Louisiana delta survey unit includes the flood plains of the Mississippi Basin that are north of the Red River in Louisiana and south of Vicksburg in Mississippi. These flood plains, shown in figure 1, extend west to the hills in the former State and east to the bluffs in the latter. The total land area, exclusive of meandered lakes and rivers, is 3,897,000 acres, of which 250,200 acres are in Mississippi.

Topography and Drainage

Local streams are numerous, large, winding, and sluggish. During flood times, soil-laden waters overflow the river banks and drop their alluvium. Much soil settles near the stream margins; less, farther back. In this manner low ridges or "front lands" are built up along each river bank. Rivers also scour away their banks on the convex side of bends and build up mud and sand bars elsewhere. This constant shifting of streams possibly justifies the assertion that at one time or another every acre of the Mississippi River bottom land was actual stream bed.

Before the construction of the present levee system, much of this section was subject to a spring flood nearly every year. Exceptional floods covered all but the highest part of Macon Ridge and a few of the higher river margins. The present levee system affords much better protection. Exceptionally destructive floods, such as those in 1927, may cover wide areas, but ordinary high waters now cover only the extensive flats lying south of Jonesville and Ferriday. Annual inundation in some degree, however, either by overflow or concentration of local rain water is characteristic of the stippled areas shown in figure 1. Elsewhere rainfall during the winter season covers the bottoms

of local streams and restricted areas on the lower flats. This survey unit as a whole, however, is not characteristically a swamp country; swamps, properly speaking, are of restricted occurrence.

The unit is made up entirely of present flood plains or first bottoms and of ancient flood plains in the form of second bottoms and higher terraces. The present flood plains seldom vary more than 12 to 15 feet in elevation, the higher elevations lying along courses of present or former streams. Macon Ridge, rising about 30 feet above the present flood plain, is the unit's principal topographic feature.

Soils

The soils of this unit fall naturally into three distinct soil groups (fig. 1). The first group is characteristic of the present flood plain of the Mississippi River itself, and lies east and south of Macon Ridge. The second is found on the present flood plains of the Ouachita and Boeuf River systems. The third group occurs on Macon Ridge itself and on the adjacent lower terraces or second bottoms to the west.

Soils of the Mississippi River flood plain are typically gray to black and vary from pure clays to very fine silty sand. Sands and sandy clays make up most of the natural levees or low ridges adjacent to present or former streams. Alternating with these sandy ridges are flat, poorly drained areas where the soils vary from silty clays to impervious waxy clays. South of Macon Ridge, clay soils predominate.

On the flood plains of the Ouachita and Boeuf River systems reddish soils prevail. They are chiefly deposits of alluvium from the Arkansas River brought down through Bayou Bartholomew and the Boeuf River. Those soils also vary in tex-

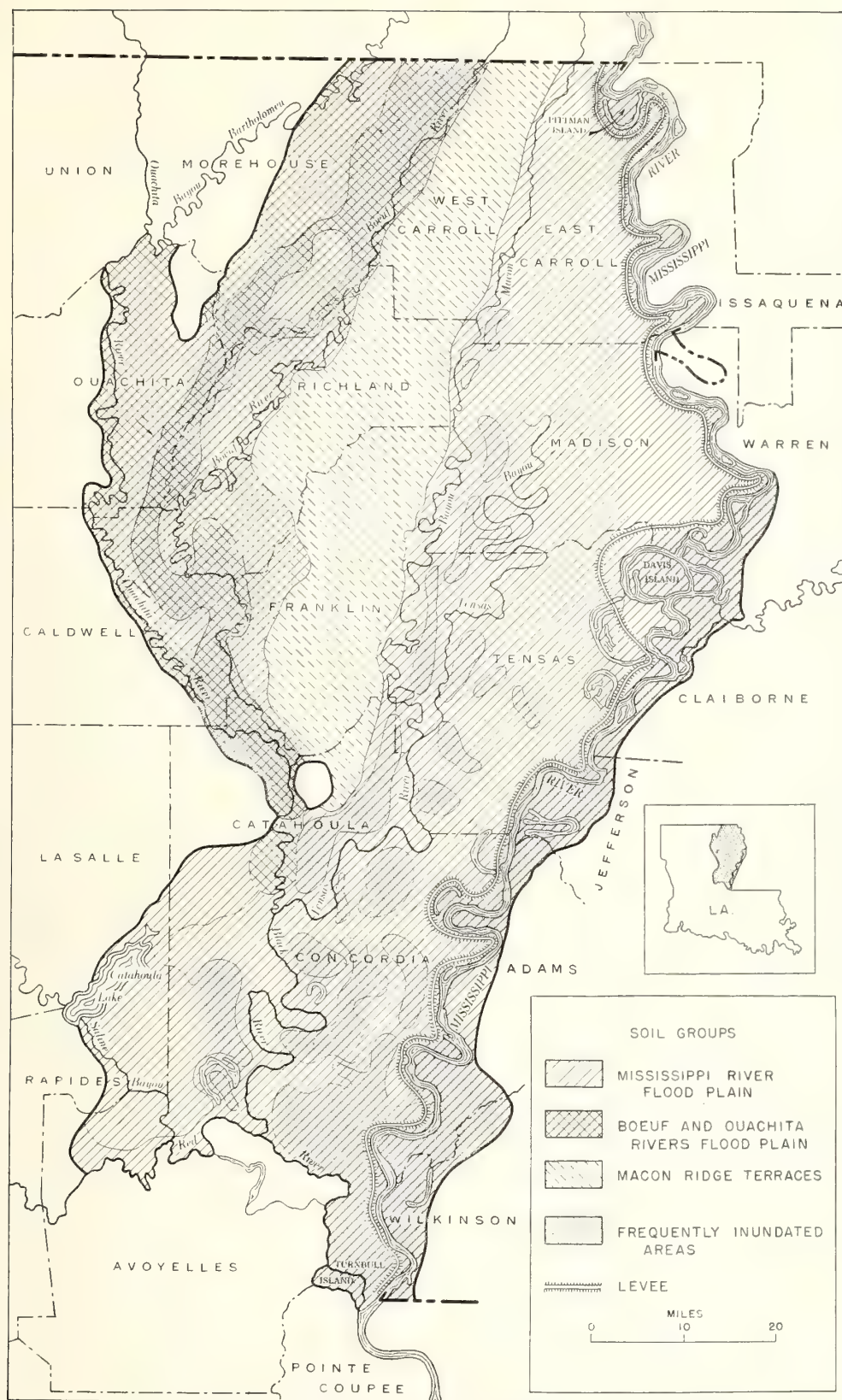


FIGURE 1.—Soil groups in the north-Louisiana delta. Stippled areas are approximately those over which inundation is common; they may include local areas that are higher and better drained

ture from pure clays to very fine sands. Waxy clays predominate in the La Fourche Basin and in the basins in the upper and lower ends of Boeuf River.

The terrace soils vary less than those of the other two groups. Sands and clays of the river flood plain or first bottoms are almost entirely lacking here. With respect to its soils, the terrace can be divided into two subareas. On the highest terrace, or ridge proper, the soils are almost entirely silt loam, yellowish to buff in color. On the lower terraces or second bottoms to the west they are similar except for the common occurrence of poorly drained, saucer-shaped depressions where the soils are light gray and of the consistency of silty clay loam.

In general, the survey unit is characterized by very good agricultural soils. On the river flood plains the front lands are uniformly of the highest quality. After drainage the black "buckshot" soils of cypress sloughs and swamps are of equal or greater agricultural worth. Soils of the flats are variable; some, with or without drainage, are of good quality when carefully worked; the most waxy soils, however, in spite of drainage and careful working, cannot be considered as agricultural. On the terrace the buff loam soils are good to excellent. The grayish soils of the saucerlike depressions are not good agriculturally even after drainage. The proportion of tillable land acreage is higher on the terrace than on the river flood plains.

Climate

Short, mild, rainy winters, and long, very warm and humid summers are characteristic of this unit. Even in the most northern part, water freezes only three to five times during the average winter. On the average, snow falls once a year. The mean annual temperature is about 66° F.; for the winter months (December, January, February) the mean temperature is 50°, and for the summer (June, July, and August) 81°. The last killing frost in the spring usually occurs during the middle of March, and the first killing frost in the fall generally comes early in November. Prevailing winds are southerly. The average annual rainfall is 50 inches.

Although logging is more or less restricted during the winter and may be impossible on low wet situations, it is nevertheless a year-round activity. Logging conditions are normally most favorable during the relatively dry months of fall.

History and Development

Settlement in the unit began early in the nineteenth century. Early settlers came largely from Southern States farther east. By 1850, cotton was being produced on much of the relatively high river-front land where water transportation was easily available. These lands lay mainly along the Mississippi, Tensas, and Ouachita Rivers, the middle reaches of Boeuf River, and along Bayous Macon and Bartholomew. Cotton production in those days was virtually the only industry in the unit.

During the Civil War and the subsequent reconstruction period, agricultural development was interrupted. Thousands of acres of rich plantation lands were permanently abandoned and reverted to forest growth (fig. 2). In the 1880's cotton production was revived, and a new period of development set in, during which cotton cultivation rapidly extended to newly cleared lands in the better drained situations accessible to the recently constructed railroads. Water transportation ceased to be the most important agent in cotton shipping, and land continued to be abandoned along some of the rivers and bayous where rail facilities were not easily available.

Cotton production remained almost the sole industry in the survey unit until the early 1900's. Somewhat prior to that time, however, a few small sawmills operated on Macon Ridge, and handdriven staves were made there. Shortly after 1900 large lumber interests began to acquire timberland, and within the next 10 years lumber production began to be an important industry. On Macon Ridge and the adjacent terrace it reached its peak between 1915 and 1920; in the remainder of the unit, between 1922 and 1928.

The agricultural boom occasioned by the World War started a well-defined movement to put cut-over timberlands into agriculture, principally for cotton production. This tendency was particularly apparent west of Macon Ridge on the low terrace which had not been highly developed agriculturally up to that time. Expansion of cotton acreage continued, although at a gradually diminishing rate, until the depression following 1930. By this time, the area of land cleared annually was almost equaled by the area of agricultural land left idle and abandoned. During the recent years of low

cotton prices a notable increase in the production of livestock, particularly of cattle and hogs, has been apparent, but the alluvial soils of this unit are in general high cotton producers, and cotton may be expected to continue as the most important agricultural crop.

During the agricultural boom of the World War period, several local drainage districts, aggregating approximately 150,000 acres, were organized in the more poorly drained bottom lands. Bonds were issued in each district to cover the cost of drainage improvements. These bonds were to be retired by money raised from both acreage and ad valorem taxes levied on all land within the drainage district. Even in normal times these taxes were burdensome; but during the recent depression the tax situation became so acute that nonpayment of taxes on these lands has been common. Although not all land is now cleared that could be put to agricultural uses, the expense of drainage improvements definitely limits the area of forested land that can be cleared and cultivated profitably under ordinary conditions.

Besides agriculture and the forest industries, the natural-gas industry is also well developed. The Monroe gas field, lying almost entirely within this survey unit, is one of the largest in the world. It supports a very large carbon-black industry and a secondary oil industry. A large electric generating plant uses the natural gas for fuel. Sash and door plants constitute the only other industry of consequence. There are no hydro-electric plants.

Highway, waterway, and railroad transportation facilities are well distributed. Four railroad systems serve this section—the Missouri Pacific, the Illinois Central, the Louisiana & Arkansas, and the Texas & Pacific. Very little of the land area in the unit is more than 10 miles from an improved highway or other form of transportation. (See map of forest industries and transportation systems, fig. 8, which also shows the navigable portions of streams.) The roads are in general hard-surfaced or graveled.

Land Use and Ownership

Of the total land area of the unit in 1934, about 69 percent was in forests, 29 percent in agriculture, and 2 percent in other uses (table 1). Most of the land is owned either by agricultural or timber interests. The agricultural ownership is of two fairly distinct



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FIGURE 2.—Ruins of an ante bellum plantation house now literally overgrown with a second-growth sawlog-size forest, Tensas Parish, La. This house at one time was surrounded by approximately 3,000 acres of highly productive cotton land. Now scarcely 25 acres are under cultivation. The remainder of the area supports a stand of second growth, a part of which was recently cut over for sawlogs

kinds—large-scale plantations and small farms. The plantation system prevails almost exclusively in the Mississippi River and Boeuf-Ouachita flood plains. Although plantations are established in the terrace and second bottoms, somewhat more than half the land held by agricultural interests in this section is in independent, small-farm ownership, much of which has developed since the lumber companies began to promote the sale of cut-over lands for agricultural purposes. Many farmers moved into the territory from the hills of the nearby piney woods to the west.

It is estimated that farmers and planters own slightly more than one-half of the timberland on the terrace and second bottoms, and about one-third of that on the flood plains of the Mississippi and other streams. The largest of the plantation holdings of forest land is about 12,000 acres; only a few exceed 5,000 acres (table 2). Timber operators

TABLE 1.—*Land area classified according to major uses*

Land-use class	Total land area	
	Acres	Percent
Forest:		
Productive.....	2,656,500	68.2
Nonproductive.....	26,200	.7
Total.....	2,682,700	68.9
Agricultural:		
In cultivation:		
Old cropland ¹	847,700	21.8
New cropland ²	91,000	2.3
Out of cultivation:		
Idle ³	43,800	1.1
Abandoned ⁴	28,800	.7
Improved pasture ⁵	104,600	2.7
Total.....	1,115,900	28.6
Other—prairie, marsh, waterways, ⁶ towns and villages, roads, railroads, etc.....	98,400	2.5
Grand total.....	7 3,897,000	100.0

¹ Land cultivated at least 5 years and on which a farm crop was raised within 2 years prior to the date of survey.

² Land converted from forest to cropland within 5 years prior to the date of survey.

³ Cultivated land that has been idle for 2 years or more but has not reached the abandoned stage.

⁴ Land once cultivated but showing distinct evidence of having been abandoned for agricultural crop production; no attempt has been made to maintain it as improved pasture.

⁵ Cleared land under fence used primarily for grazing; a real attempt has been made to produce and maintain a sod.

⁶ Does not include meandered lakes and rivers.

⁷ Includes 9,262 acres in Pittman Island, a part of Mississippi.

TABLE 2.—*Total forest area¹ classified according to type of ownership and size of forest-land holding*

Size of forest-land holding (acres)	Operators active in unit holding forest land only	Other owners holding forest land only	Plantation owners	Farm owners	All owners
	Percent	Percent	Percent	Percent	Percent
Under 320.....	(?)	2.5	2	12	16.5
320 to 1,999.....	2	5	16	.....	23
2,000 to 14,999.....	2	3.5	12	.....	17.5
15,000 to 39,999.....	4	10	.....	.....	14
40,000 and over.....	16	13	.....	.....	³ 29
Total.....	24	34	30	12	100

¹ Based on data taken at parish courthouses in Louisiana. No comparable information is available for the 250,200 acres in Mississippi. Probably the character of ownership does not differ greatly from that shown above for the area in Louisiana.

² Less than 0.5 percent.

³ This 29 percent of the total forest area is owned by 10 firms; 4 of these hold as much as 60,000 acres of virgin timberland each.

and timber-holding companies own approximately 58 percent of the total forest area. Although less than half of this is in the hands of owners having active logging operations in the unit, these owners hold some 55 percent of the area of uncut old-growth timber. One active operator has about 100,000 acres of this class of timberland; another, 60,000 acres. The other areas of uncut old-growth timber, one owned by an operator not now working in the unit and the other by a timber-holding company, contain 60,000 to 70,000 acres each. Holdings of old-growth uncut timber by agricultural owners are negligible. There is no national forest or organized State forest land in the unit.

Taxation

Timberland owners in the north-Louisiana delta are vitally concerned with land- and timber-taxation practices. Two kinds of general property taxes are levied—ad valorem taxes and taxes assessed at a flat rate per acre. In addition, a severance tax is collected on the volume of all timber cut. This varies between 7 and 26 cents per thousand board feet, depending on species.

Ad valorem taxation practiced here is similar to that generally practiced elsewhere. In theory, rural real estate is assessed at full valuation, but in practice, agricultural lands, farm woodlands, and merchantable timberland are assessed in normal times at about 50 to 60 percent of full valuation. Under the depression conditions existing in 1934, the realizable value of this kind of real estate had shrunk to the point where assessed valuation and realizable value were approximately equal. Cut-over timberland and similar wild lands are assessed in normal times at virtually 100 percent of their realizable value. Hence, the assessed value of lands of this class in 1934 was considerably higher than the realizable value for such property.

Practices in assessing any given class of real property vary somewhat from parish¹ to parish. In some parishes, timber and land together are assessed at a flat rate. In others, the timber volume is assessed at a given rate per thousand board feet, and the land carries an additional assessment at a given rate per acre. Considering assessments ac-

¹ Parishes in Louisiana correspond to counties in other States.

cording to both systems, the assessment per acre on virgin timberland varies from a minimum of \$6 to \$8 per acre for the overcup oak-bitter pecan flats in Concordia Parish to a maximum of \$30 to \$35 per acre for the more valuable areas. An average assessment rate for virgin hardwood timberland in this unit would be about \$20 per acre. Assessments on cut-over timberland range from \$1 to \$12 per acre, with an average of about \$6 per acre.

A third classification of taxable timberland is recognized throughout Louisiana. This classification is designated "woodland" and can be roughly described as the kind of partly cut-over timberland commonly found in connection with farms or plantations. These stands normally contain a larger volume of timber of merchantable size than the commercially cut-over timberlands and are therefore assessed at a value per acre intermediate between the highly valued old-growth timber areas and the cut-over timberland. The tax saving as a result of a partial cutting of old-growth uncut hardwood areas and the subsequent classification of the area as "woodland" is a substantial inducement for holders of large tracts of virgin timberland to practice some form of forest management.

The tax rate ranges between 17 and 65 mills per dollar of assessed valuation, usually around 30 to 35 mills.

Besides the ad valorem tax, a substantial part of the land is subject to an annual flat-rate levee tax of 5 cents per acre. Furthermore, for the small area included in organized drainage districts, an additional annual tax of 5 to 50 cents per acre is levied for drainage improvements.

Only a part of the above taxes apply to the batture land, that is, the unprotected land lying between the levee and the river. State, parish, and school taxes are usually levied on batture land; but the assessed valuation is much lower than for comparable levee-protected land. Drainage, levee, road, and other miscellaneous taxes are not usually charged against batture land. The total annual tax per acre for batture land in this unit bearing a stand of almost mature second growth averages approximately 7 cents per acre. A corresponding total annual tax for similar timberland on the protected side of the levee is approximately 30 cents an acre. The difference of 23 cents represents the tax advantage of timberland located on the batture.

Although taxation lays on the landowners a genuine burden that has resulted in some delinquency, the problem of reversion of title to the State for nonpayment of taxes is not acute. Officers of a few of the parishes reported no tax-reverted land in 1934; others reported small acreages. Concordia Parish reported approximately 50,000 acres of tax-reverted timberland in 1934; this was the largest area to be reported by any parish. Tax delinquency is, of course, more common than tax reversion and is more common on urban property than on rural property. In 1934 the acreage of tax-delinquent timberland was less than the corresponding acreage of farm land.

Population and Community Conditions

This unit is largely a region of rural dwellers. Its total population numbers about 210,000 (or 34 persons per square mile) of which only 20 percent lives in the five cities that have more than 2,500 persons each. Monroe and West Monroe have populations of 26,000 and 7,000, respectively, but the other three (Tallulah, Lake Providence, and Ferriday) have less than 3,500 persons each. Whites make up 53 percent of the total population—61 percent of the urban, and 50 percent of the rural. The colored rural dwellers are mainly sharecroppers on cotton plantations; many of the white rural dwellers are independent farmers. The median size of family is approximately 4 persons per white and 3 persons per colored family.

The unit has a plentiful supply of cheap labor, white as well as colored. The laborers on large-scale forest-products operations are largely regular full-time woods and mill workers and for the most part are colored. On small-scale operations, and particularly in the woods, the labor is more often transient. This transient, part-time help comes from two general sources—farm laborers, and odd-job laborers who alternate between woods work and other temporary jobs, such as road and construction work, fishing, hunting, and trapping.

Most of the towns and cities originated at centers of the cotton trade in the early 1800's. The more recent coming of the lumber industry merely added to the size of already-existing communities. Exceptions to this rule are Ferriday and Waterproof, which developed near the end of the nine-

teenth century as combined agricultural and sawmill communities. Some towns in the unit have already experienced the passing of their local sawmill industry. Although this passing has temporarily handicapped them, it has not, as a rule, resulted in the disastrous social consequences that so often befall abandoned sawmill towns elsewhere. Most of the mill towns in this unit will continue as

agricultural centers, supported by plantations and small farms. There are, however, a few very small communities, such as Tendal and Sondheimer, consisting of little more than a sawmill, a commissary, and the necessary quota of company-owned houses, which may practically pass out of existence with the removal of the present sawmills.

Forest Description

THE forest area of the survey unit is in general a mixed hardwood forest, where the typical stand is made up of trees of many sizes and ages. More than 20 percent still bears uncut old-growth timber. Nearly 80 percent has at one time or another been cut over for sawlogs or other forest products. At the time of cutting, these areas were largely stripped of the timber that had the quality required by the lumber, veneer, and cooperage industries. Nevertheless, at the present time nearly 64 percent of the total board-foot volume in the survey unit is found on areas once cut over. Although a part of this volume is in residual trees left at the time of logging, more than 40 percent is found in trees less than 19 inches in diameter. In addition, nearly 8 million cords of wood are found in trees below sawlog size. Growth of trees less than 19 inches in diameter is rapid. Because this rapid-growing component of the forest is increasing its volume very much faster than it is being used, a relatively large growing stock is being built up on which future operations may depend. With shifts in market, changes in technical processes of manufacture, and improvement in timber quality as a result of growth, this growing stock of residual and second-growth timber can eventually serve as the basis for commercial cuttings.

Forest Types

The species association in the eight principal forest types as disclosed in the analysis of the field data is given in table 3. The relative importance of each species¹ or species group is expressed as a percent of the cubic-foot volume of all species occurring in the type. The areas dominated by six of these

¹ Latin names of species mentioned in the text are given on p. 48.

forest types are shown in a broad and generalized manner on the map at the end of this report. Areas of the other two types are too small or scattered to be included. Because the distribution of these types was seen to be closely related to topography, the forest area was classified in the field into four topographic-situation classes, defined as follows:

Swamp.—Forested areas normally under water during the greater portion of the year.

Terrace.—Nonswampy ancient flood plains now above the level of all but exceptional floods.

River margin.—Relatively high sandy areas adjacent to present or recent stream courses and comprising the most recent alluvial deposits in the delta.

Bottomland.—Present flood plains which cannot be classified as swamp or river margin.

As shown in table 4, three-fourths of the forest area in this unit is bottom land. The red gum-water oak type is almost wholly confined to these bottom-land areas—as is the hackberry-elm-ash type, which is largely a residual type left after the red gum-water oak type has been commercially logged. Where the red gum-water oak type occurs on front lands, the land when cleared is usually valuable for agriculture even without drainage. The overcup oak-bitter pecan type is found on the poorly drained, waxy clay soils of the backwater areas in the bottom land, as well as in shallow sloughs and local basins scattered throughout the bottom land and on the terrace. Even when drained, the soils of this latter type are usually undesirable for agriculture. The cypress-tupelo type is found mainly in deep swamps and on the fertile buckshot soil of deep wet sloughs.

The cottonwood-willow type is in reality two separate but closely related river-margin types. The two species seldom grow together except in young stands. Cottonwood in pure stands usually grows on high, sandy river margins, or on old fields.

TABLE 3.—Composition of each of the principal forest types, by species, expressed in percent of total gross cubic volume ¹

Species	Red gum-water oak	Hackberry elm-ash	Overcup oak-bitter pecan	Cottonwood-willow	Cypress-tupelo	Water oak	Mixed oak-mixed hardwood	Pine hardwood	Average (weighted), all types
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Red gum.....	39.3	1.6	0.6	1.5	1.8	3.4	17.3	12.5	13.9
Water oaks ²	19.7	9.4	8.4	(³)	1.3	66.9	14.9	8.7	15.1
Overcup oak.....	6.8	6.5	36.5	.1	2.2	3.6	3.9	2.7	13.9
White oaks ⁴	.4	.1	(³)		(³)	2.0	17.2	10.7	1.3
Red oaks ⁵	.1	.1	(³)			.7	9.6	4.0	.7
Bitter pecan.....	3.5	5.4	34.9	1.3	4.2	2.2	1.9		12.3
Sweet pecan.....	4.3	1.2	.3	.5	.1	1.3	.9		1.7
Green ash.....	5.1	13.2	4.9	.6	4.0	3.5			6.0
White ash.....		.5	.1			1.0	3.3	1.2	.4
White elm.....	4.8	9.0	1.8	.3	.8	4.7	2.8	.9	3.8
Rock or cedar elm.....	2.9	13.0	2.6			1.9	3.3		4.6
Winged and red elm.....	.1	1.2				2.2	4.8	2.8	.7
Hackberry.....	4.7	21.4	3.3	.5	.2	2.4	.7		5.6
Cottonwood.....	.8	.1	.1	39.9	.5	.1	.1		4.2
Willow.....	.2	.4	.2	52.4	2.7	(³)	.1		5.4
Cypress.....	.8	.1	1.5	.6	40.2	(³)	.3		2.4
Tupelo gum.....	(³)		(³)	.1	37.4				1.5
Black gum.....	.6	.2	.1			.9	6.9	3.0	.7
Hickory.....	.1	.1	(³)			.4	7.6	4.5	.5
Red maple and boxelder.....	1.3	1.9	(³)	.2	1.0	.6	.8	.5	.8
Sycamore.....	.5	.8							.3
Persimmon.....	.9	1.0	2.6	.3	1.1	.6	.6		1.3
Other hardwoods ⁶	3.1	2.8	2.1	.9	2.5	1.5	.9	.1	2.3
Loblolly pine.....	(³)	(³)				.1	2.1	48.4	.6

¹ Total gross cubic volume includes bark in stemwood of good trees 5 inches and over in diameter.² Chiefly water oak, bottom land red oak, and willow oak.³ Less than 0.1 percent.⁴ Cow oak, forked-leaf white oak, and delta post oak.⁵ Chiefly cherrybark oak, southern red oak, and black oak.⁶ Chiefly honeylocust, mulberry, and water locust.

TABLE 4.—Distribution of forest area according to forest type and topographic situation

Forest type	Bottom land	Terrace	Swamp	River margin	All situations	
	Acres	Acres	Acres	Acres	Acres	Percent
Red gum-water oak.....	659,900	10,100	2,500	9,500	682,000	25.4
Hackberry, elm-ash.....	386,300	16,000	1,700		404,000	15.1
Overcup oak-bitter pecan.....	772,400	21,900	14,300	3,700	812,300	30.2
Cottonwood-willow.....	30,500		48,900	139,600	219,000	8.2
Cypress-tupelo.....	11,000	1,700	82,400		95,100	3.5
Water oak.....	135,900	59,000			194,900	7.3
Mixed oak-mixed hardwood.....	51,400	193,700	1,700		246,800	9.2
Pine-hardwood.....		28,600			28,600	1.1
Total.....	2,047,400	331,000	151,500	152,800	2,682,700	
All types, percent.....	76.3	12.3	5.7	5.7		100.0

Pure willow stands are commonly found on the low banks along rivers or in swamps.

The water-oak type grows on either wet gumbo flats or the occasional clay ridges in the bottom land, and in poorly drained, saucer-shaped depressions on the terrace. On bottom-land situations, bottom-land red oak and willow oak are the predominating individual species on flats and ridges, respectively. On the terrace, willow oak with some

admixed water oak are the principal species. The mixed oak-mixed hardwood type is characteristic of the better terrace soils, but this type exists also in the bottom lands, where it is largely restricted to the reddish Portland and Miller soils in the Bayou Bartholomew Basin and to the Ouachita River alluvium. The pine-hardwood type, which is essentially the mixed oak-mixed hardwood type plus loblolly pine, is found exclusively on the terrace.

Forest land was not classified according to site—that is, its forest-producing capacity—because, except for areas bearing the overcup oak-bitter pecan type, nearly all land in this survey unit is intrinsically of high forest productivity and for the most part is believed to have a forest-producing capacity considerably above the average hardwood site in the upland and mountainous parts of the South.

Forest Conditions

The forest was divided into eight condition classes on the basis of volume, age, and cutting history. They are as follows:

Old growth—Uncut.—The original mature forest of the region from which less than 10 percent of the volume has been cut (fig. 3).

Partly cut.—Stands from which at least 10 percent of the volume of the original old-growth forest has been removed, but which are still characterized by residual old-growth trees.

*Second growth*²—*Sawlog size, uncut.*—Second-growth stands that contain at least 600 board feet per acre in second-growth trees of sawlog size (13 inches d. b. h. and larger) and from

² In each of the three second-growth conditions, residual old-growth timber commonly occurs, but not in sufficient quantity to characterize the area as old growth.

which not over 10 percent of the volume in second-growth sawlog-size trees has been cut.

Sawlog size, partly cut.—Second-growth stands from which more than 10 percent of the volume in second-growth sawlog-size trees has been cut, but which still contain at least 400 board feet per acre in second-growth trees of this size (fig. 4).

Under sawlog size.—Stands characterized by second-growth trees 1 inch or larger in diameter and in which the volume of second-growth saw timber is insufficient to permit classification under the appropriate sawlog-size condition (fig. 5).

Reproduction.—Areas of second growth not falling into any of the other conditions and bearing more than 80 seedlings per acre less than 1 inch d. b. h. Stands in this condition may contain an occasional sapling or residual tree of sawlog size.

Clear-cut.—Forest land that does not bear sufficient forest growth to be classified in one of the preceding conditions. Stands in this condition, however, may contain an occasional sapling or residual tree of sawlog size.

Nonproductive.—Forest areas that are monopolized by a forest growth of no economic value, such as buttonbush or privet.

In classifying forest lands by type and condition, certain arbitrary policies were necessarily established. In general, the distinction between old-growth and second-growth stands has been based on the growth habits of trees in the stand rather than on their size. In some instances, where the



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FIGURE 3.—Old-growth uncut stand of the red gum-water oak type. The principal species are red gum, hackberry, bottom land red oak, and green ash

growth rate of residual stands from cuttings made 20 or more years ago had so accelerated that the stands had taken on the general characteristics of second growth, they were so classified, regardless of tree size. None of the cottonwood-willow type has been classed as old growth. Because this type usually grows on new-made land on river banks, or on old fields, and usually passes through but one short rotation as a distinct type, it uniformly exhibits second-growth characteristics. For similar reasons, the hackberry-elm-ash type on new-made land and all types on abandoned clearings have always been classed as second growth, or reproduction.

Table 5 classifies the forest area by forest type and forest condition. In interpreting this table, it must not be inferred that there is always a direct relationship between the partly cut areas of a given type and the uncut areas of the same type. For example, it is not to be assumed that the 186,300 acres of old-growth partly cut hackberry-elm-ash type was at one time uncut old growth of this same type. As a matter of fact, a large part of this area was originally in old-growth uncut red gum-water oak. Commercial cutting removed the red gum and part of the water oaks, leaving a stand in which hackberry, elm, and ash predominated. Similarly, part of the 266,500 acres of old-growth partly cut overcup oak-bitter pecan type was at one time old-growth uncut red gum-water oak.

Old-growth partly cut stands are of two distinct kinds—stands that have been lightly cut, commercially speaking, and stands that have been subjected to a full commercial cutting that removed

all timber suitable for the manufacture of lumber, cooperage, and veneer. A large part of the 709,000 acres in the old-growth partly cut condition falls into this latter class. In most cases these stands are actually much less attractive to timber operators than the second-growth sawlog-size uncut stands of a similar mixture of species.

In a general way, the area of old-growth uncut timber in any given type shown in table 5 reflects inversely the length of time the species in the type have been commercially important in the unit. The area in this condition in the mixed oak-mixed hardwood type is very small because since early days this type has been cut for its valuable white oak, ash, and hickory. Later, the commercial demand for cypress timber developed, reducing to approximately 15,000 acres the old-growth uncut condition in the cypress-tupelo type. Immediately following the World War, the red gum and water oaks, conspicuous in the red gum-water oak type, became of major commercial importance in this unit. Since these species are the most recent to bear the brunt of commercial exploitation, a relatively large area of uncut old growth remains in this type. Inasmuch as overcup oak and bitter pecan are still among the less desirable species, the old-growth uncut area in this type remains large.

Less than 5 percent of the total forest area is in the reproduction and clear-cut conditions. This indicates that commercial cutting in the delta hardwoods is a selective process and that cut-over lands invariably have a residual stand that prevents their being classified as clear-cut areas. More than

TABLE 5.—Distribution of total forest area by forest type and forest condition

Forest condition	Red gum-water oak	Hackberry-elm-ash	Overcup oak-bitter pecan	Cottonwood-willow	Cypress-tupelo	Water oak	Mixed oak-mixed hardwood	Pine-hardwood	All types	
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Percent
Old-growth:										
Uncut.....	117,300	57,300	369,400		14,800	16,300	¹ 2,500		577,600	21.5
Partly cut.....	104,700	186,300	266,500		21,000	74,100	54,700	1,700	709,000	26.5
Second-growth sawlog size:										
Uncut.....	206,700	76,700	83,900	120,000	31,700	48,000	50,600	10,900	628,500	23.4
Partly cut.....	66,000	21,300	11,800	9,500	4,400	28,700	48,000	5,900	195,600	7.3
Second-growth under sawlog size.....	148,500	60,700	56,000	57,600	8,000	27,000	56,500	6,700	421,000	15.7
Reproduction.....	21,100	1,700	12,000	16,700			14,300	1,700	67,500	2.5
Clear-cut.....	17,700		7,600	3,400	5,900	800	20,200	1,700	57,300	2.1
Nonproductive.....			5,100	11,800	9,300				26,200	1.0
Total.....	682,000	404,000	812,300	219,000	95,100	194,900	246,800	28,600	2,682,700	
All conditions (percent).....	25.4	15.1	30.2	8.2	3.5	7.3	9.2	1.1		100.0

¹ The sampling method used gave the areas shown: Estimates of small areas in the less common types and conditions may be in error; this 2,500 acres, for example, is known to be too small.

one-third of the 57,300 acres of clear-cut condition is in the mixed oak-mixed hardwood type. This type is found almost entirely on the terrace, where small scattered individual farm ownerships abound. Here fuel-wood cuttings, grazing, and fires have caused a larger proportion of clear-cut land to be in this type than elsewhere in the unit.

The nonproductive forest does not occur in large and continuous areas, but is in small islands scattered throughout the forest. Nonproductive areas in the overcup oak-bitter pecan type are commonly occupied by planer tree and privet; in the cypress-tupelo type, by buttonbush; and in the cottonwood-willow type, by malformed noncommercial willow.

Tree Size-Class Distribution

A general concept of the character of the hardwood forest of the unit can best be obtained through a study of table 6 (for more detail see tables 18 and 19 in the appendix), which gives the number of trees, by diameter-class groups,³ in four forest conditions. Broadly speaking, the forest is made up of cull trees and good trees. Cull trees

³ The survey recognizes 2-inch diameter classes; as for example, the 14-inch class whose limits are 13 and 14.9 inches.



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FIGURE 4.—Second-growth sawlog-size partly cut stand of the water-oak type. The large central tree is about to be felled



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FIGURE 5.—Second-growth under sawlog-size stand of the red gum-water oak type

can be further classified as sound and rotten. Sound culls are those trees which on account of form, crook, extreme limbiness, or other defect of sound trees do not now and in all probability will never produce one usable sawlog at least 12 feet long. Rotten cull trees are (1) sawlog-size trees containing 50 percent or more of their board-foot volume in logs culled because of rot, and (2) trees below sawlog size containing 50 percent or more of their cubic-foot volume in rotten material. Good trees are all others; they are potentially usable saw timber because they either now contain or can be expected eventually to contain material usable as common sawlogs.

The figures in table 6 reflect the fact that commercial logging for the production of industrial lumber, cooperage, and veneer is a selective process, in which only a part of the trees of sawlog size are cut. This table shows an average of 11.8 good trees per acre over 19 inches in diameter in the old-growth uncut condition, and 6.7 trees of the same size in the old-growth partly cut condition. The difference of 5.1 trees in a general way represents the influence of cutting.

Allowing for the fact that trees on the partly cut areas have grown since the cutting date, com-

mercial logging probably removes only about half the good trees in and above the 20-inch diameter class. Cutting is still more selective in the smaller size classes. In the old-growth uncut condition 12.4 trees per acre are shown in the 14- to 18-inch diameter class, whereas 10.9 trees are found in the old-growth partly cut condition.

Largely as a result of past fires and logging history in the north-Louisiana delta hardwood stands, cull trees generally make up one-fourth to one-third of the total number of trees in a given stand. Commercial cutting in these stands removes some of the good trees of sawlog size but leaves all (or nearly all) the cull trees. In practically all forest conditions, rotten cull trees are more abundant than sound culls in and above the 20-inch diameter class, whereas the sound culls are the more common in the smaller sizes. Considering trees of sawlog size only, the second-growth sawlog-size stand has a relatively small proportion of cull trees.

Commercial Forest

For further descriptive purposes the total forest area has been subdivided into commercial and

TABLE 6.—Average number of trees per acre, by forest condition and diameter-class group

Forest condition and tree class	2-4 inches, d. b. h.	6-12 inches, d. b. h.	14-18 inches, d. b. h.	20-28 inches, d. b. h.	30-38 inches, d. b. h.	40+ inches, d. b. h.	All diameters
Old growth, uncut:	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Good.....	53.7	30.8	12.4	9.1	2.2	0.5	108.7
Sound cull.....	47.3	10.0	1.8	.6	.1	(¹)	59.8
Rotten cull.....	2.2	1.3	.6	.8	.6	.1	5.6
Total.....	103.2	42.1	14.8	10.5	2.9	.6	174.1
Old growth, partly cut:							
Good.....	65.3	29.6	10.9	5.9	.7	.1	112.5
Sound cull.....	33.7	11.3	1.9	.7	(¹)	(¹)	47.6
Rotten cull.....	1.2	1.5	.9	1.1	.4	.1	5.2
Total.....	100.2	42.4	13.7	7.7	1.1	.2	165.3
Second growth, sawlog size (uncut):							
Good.....	76.2	53.7	17.8	6.6	.4	(¹)	154.7
Sound cull.....	38.0	12.1	1.7	.5	.1	(¹)	52.4
Rotten cull.....	1.7	1.8	.8	.7	.2	.1	5.3
Total.....	115.9	67.6	20.3	7.8	.7	.1	212.4
Second growth, under sawlog size:							
Good.....	260.9	48.4	3.4	1.0	.2	(¹)	313.9
Sound cull.....	69.7	11.5	1.5	.4	(¹)	(¹)	83.1
Rotten cull.....	1.8	2.2	.7	.5	.2	(¹)	5.4
Total.....	332.4	62.1	5.6	1.9	.4	(¹)	402.4

¹ Less than 0.1 tree per acre.

noncommercial areas. By a commercial forest area is meant one that supports a stand of adequate quality and volume per acre to warrant operation under ordinary circumstances for such products as industrial lumber, cooperage, or veneer; while noncommercial areas include all forest lands that do not meet these qualifications. Practically the whole of the Mississippi River Delta is accessible for logging during some season of the year. Most of it can be reached by trucks, thus making expensive logging improvements unnecessary. Furthermore, plantation tenants, small farm owners, and independent woods workers throughout the Delta are usually eager to get part-time woods work or to take small contract-logging jobs. On account of the accessibility of timber and the availability of labor, operators in the north-Louisiana delta generally find it feasible to log areas bearing 1,000 board feet or more per acre of high-grade material, by which is meant logs or bolts of the quality commonly accepted at full value on the open market by the lumber and cooperage industry. Material of this quality was recognized as such, regardless of present commercial value of the species in which it occurred. Thus it is possible to recognize high-grade material in such species as honeylocust, cedar elm, and bitter pecan, wherever the quality is equivalent to that accepted in commercial species in the open market at full scale and price. Accordingly, commercial forest area has been defined arbitrarily as any area that bears 1,000 board feet or more per acre of high-grade material, regardless of species.

It does not necessarily follow, however, that all areas bearing 1,000 board feet of high-grade material are now attractive to operators. A small part of the commercial forest area was so classified because of high-grade material in species for which no well-developed market now exists. These areas presumably cannot be profitably logged under present market conditions. For example, occasional areas classed as commercial largely because of high-grade volume in such species as cedar elm, honeylocust, and bitter pecan are at present unattractive to commercial operators. On the other hand, a few cutting operations under particularly favorable conditions are actually under way on other areas that contain less than 1,000 board feet per acre of high-grade material.

Although elsewhere in the South uncut old

growth is generally commercial, some old growth stands in the north-Louisiana delta are of such low quality that they cannot be classified as commercial forest. For example, only 13 percent of the uncut old-growth forest area in the overcup oak-bitter pecan type can be considered as commercial forest while about 20 percent of the total forest area bears commercial forests (complete figures in table 20). Only 34 percent of the total area in old-growth uncut timber can be classed as commercial forest because of the large proportion of the area that is in the overcup oak-bitter pecan type, while as much as 33 percent of the second-growth sawlog-size uncut stands can be classified as commercial.

Of the total commercial area it is estimated that about 80 percent lies north of Jonesville and Ferriday. Of the portion to the north, about 63 percent (or 50 percent of the total) is widely scattered in comparatively small isolated tracts, while the remainder (30 percent of the total), constituting the bulk of the virgin timber not in the overcup oak-bitter pecan type, is concentrated in large holdings in the Tensas River Basin in Tensas, Madison, and Franklin Parishes.

Reproduction

Bottom-land hardwood forests naturally reproduce well, as is shown by the fact that of the total open area (clear-cut and reproduction) more than half has reproduced, and most if it well. Shade, grazing, and fire are the chief obstacles to successful natural reproduction. Wherever reproduction is sparse or lacking, this condition can usually be traced to one or more of these three agencies. Vines and heavy undergrowth are also factors in reproduction of tree species on cut-over areas. It might seem that this growth would interfere with tree reproduction, but in many instances it actually protects the small seedlings from grazing animals and possibly the soil from excessive drying. Since forests of this section are generally many aged, trees in the reproduction class—that is, trees less than 1 inch d. b. h.—are in most instances merely supplemental to the overstory of mature or immature forest. Since approximately 95 percent of the forest area in this unit supports an overstory, the reproduction was in general considered adequate (table 23).

The quantity of reproduction within any forest condition is related to the forest type. Adequate

reproduction, for example, is seldom found in the cypress-tupelo type. Areas bearing stands of cottonwood or willow, which are generally even aged, usually have less than the average quantity of reproduction in sawlog-size stands and more than the average in stands below sawlog size. The pine-hardwood and mixed oak-mixed hardwood types have less than average in stands of all sizes. These two types are common in the farming country on the terrace, where grazing, repeated cutting, and fire damage have reduced the stocking of reproduction.

From the point of view of forest management, it is necessary to know not only whether reproduction can be obtained naturally, but also what species can be expected in the new crop. The oaks, particularly the water oaks, are important components of the incoming stand. Ash reproduces abundantly. Red gum, although it is scattered individually or in small groups throughout a number of forest types, seldom appears, except on old fields, as a major part of the reproduction stand. Although heavy stands of cypress were found on small areas scattered throughout the original bottom land-hardwood forest, this species is not conspicuous in the present reproduction. Under certain conditions it reproduces well; but since the installation of modern drainage improvements and levee systems, conditions favorable to natural reproduction of cypress no longer prevail in the Mississippi River bottom lands. Among the less important species commercially, persimmon and honeylocust reproduce plentifully on wet clay flats, in open grazed woods, and on sodded pastures.

Too much emphasis must not be placed on the relative abundance of given species in the reproduction stage. Some of the species which are more persistent against competition, such as red gum and the elms, are not conspicuous in this stage, but persist in the stand and increase in relative abundance. The ashes, in contrast, on account of their relative inability to endure shade, drop gradually from the stand and normally occur only as scattered individuals or groups in the mature forest. The net effect of these changes in species composition will probably result in a forest that in general will be essentially similar to the original one except as deliberate management practices and artificial drainage may locally alter the composition.

Fire Damage

Despite the widespread belief that the fire problem is not important in the delta hardwoods, 80 percent of the forest area shows evidence of having been burned over, and on more than 52 percent fire damage was apparent at the date of survey (summary of area damaged, by types, table 24). The actual damaging effect of fire is certainly greater than these figures indicate, because nearly all of the field observations were made 1 or more years after the last fire. In the meantime, evidence of damage to reproduction and small trees could have been partially or wholly erased and the seriousness of the damage to larger trees partially obscured. Fire damage is more severe on partly cut than on uncut forest areas because logging slash adds to the fuel supply and therefore tends to increase the number and severity of fires. The relative importance of the fire damage on these areas, however, is usually exaggerated because the trees already most damaged by fire are nearly always left standing at the time of logging.

The total board-foot volume lost annually on account of fire can never be determined accurately because it is impossible to ascertain definitely how much of the total cull volume in a given stand is due solely to fire damage. Board-foot volume lost by fire, as determined by the Forest Survey, has three component parts: (1) Rot or other defects traceable to fire and normally taken in logs to the sawmill or other wood-using plants; (2) fire cull left in the woods in the form of "long butts" or cull logs; and (3) trees that have become cull as a result of fire. The total board-foot volume of fire-cull material standing in the present forest is estimated to be 840 million board feet. Of this, 190 million board feet is of such a kind that it will probably be taken in logs to the wood-using plants and there classed as mill cull. An additional 120 million board feet will probably be left in the woods as culled sections of used trees. The remaining 530 million board feet is the estimated volume of living trees that have become rotten-cull material as the result of fire.

The volume of fire cull in the present stand, aggregating approximately 9 percent of the total net board-foot volume of good trees, constitutes a direct loss to the timber-land owner. The forest

has not, of course, sustained an annual loss of 9 percent. Some of the rotten-cull trees may have been fire damaged as much as 25 years ago, developing into their present rotten-cull state since that time. On the other hand, the annual loss is much more than one twenty-fifth of 9 percent, because many trees that have been fire-damaged during the past 25 years have rotted, died, and disappeared from the stand, and also because much of this loss has taken place over a considerably shorter period than 25 years. While the percentage of fire-cull volume cannot be determined exactly, it is considerable; and it can to a large extent be prevented. In 1934, no forest areas in the survey unit were under organized fire protection.

Damage Due to Other Causes

In addition to rot directly traceable to fire, there is a considerable amount of rot due to causes other

than fire. Still other timber losses are directly attributable to wind throw and wind breakage, logging damage, lightning, and other causes. Fire and rot, however, destroy incomparably more volume than all other agents combined. Hardwood trees are seldom, if ever, killed outright by insect attacks, and very little loss of timber volume is directly traceable to insect activity, although ambrosia beetles and other boring insects, some of which gain access to the tree through fire wounds, cause considerable loss in value through degrade of lumber and other commercial forest products. Also, concentrated woodland grazing near farming areas tends to reduce the quality and quantity of reproduction and may, in extreme cases, even eliminate it. Much of the forest land in the clear-cut condition is the result of elimination of reproduction by grazing, coupled with continuous cutting for local use.

Timber Inventory

THE volume estimate has been broken down into saw-timber volume expressed in board feet and into cordwood volume. In addition, the total wood content exclusive of bark, including both saw timber and cordwood, is expressed in cubic feet. The total volume, as shown in table 7, is 9,162 million board feet plus 9.6 million cords.¹

Board-Foot Volume

The board-foot volume, of 9,162 million feet does not include volume in sound-cull or rotten-cull trees. It does include the volume of all usable logs in good trees of sawlog size. Such trees are at least 13 inches d.b.h. (or at least 9 inches in pine) and contain at least one 12-foot usable log. A usable log is 10 inches or more in diameter at the small end in hardwood and 6 inches or more in pine; and at least 50 percent of its volume is suitable for the manufacture of lumber of commercial grades, low-grade structural material, low-grade box material, or railroad cross ties.

The board-foot volume has been classified as high-grade and low-grade material. High-grade hardwood material is contained in (1) lumber-mill logs and (2) other high-quality logs chiefly suit-

able for the manufacture of cooperage and small dimension stock. Lumber-mill logs of all species are those at least 14 inches (12 inches in ash) in diameter that can be expected to yield at least 30 percent or more of their volume in No. 1 common and better lumber. The average log in this class contains about 60 percent of its volume in this grade of lumber. Cooperage and small-dimension logs are 10 inches and over in diameter and of the same general quality as lumber-mill logs, but cannot be so classified because of their small diameter or excessive sweep. These small high-grade logs are suitable for industrial uses that require bolts or blocks rather than logs. High-grade material in cypress and pine includes the contents of all individual trees which will cut a minimum of 80 to 90 percent of their volume in No. 2 common and better lumber, and which in addition will generally produce 5 percent or more of their volume in firsts and seconds, or B and better lumber. Low-grade logs of all species are those that do not meet the above qualifications. In all partly cut sawlog-size conditions the high-grade volume is largely made up either of species that do not at present have a well-established market or of small logs suitable for cooperage and small-dimension stock.

Approximately 36 percent of the saw-timber volume as measured by the Scribner log rule is in old-growth uncut condition, 24 percent is in old-growth partly cut, 31 percent in second-growth sawlog-size uncut, and 9 percent in the remaining second-growth and clear-cut conditions.

Figure 6 shows the board-foot volume of timber on commercial and noncommercial forest land in each forest condition. Of the total net volume, 46 percent, or 4,240 million board feet (Scribner), is found on commercial areas (table 7). Of this, approximately 51 percent is high-grade. A relatively

¹ The total net volume of usable saw-timber material is 9,162 million board feet as measured by the Scribner log rule; 7,776 million board feet by the Doyle log rule; or 10,091 million board feet by the international one-quarter-inch log rule. The last closely approximates green lumber tally and more nearly represents the actual saw-timber volume than either of the other rules. In general, throughout this report, board-foot volumes will be expressed in Scribner log scale, but certain tables will carry volume in all three scales. The table showing the balance of growth and drain carries the international scale only. For a summary of board-foot volumes of the different species by all three log rules, with a cubic-foot summary in both sawlog and smaller trees, see table 25.

TABLE 7.—Total net volume of good trees on forest areas, classified according to forest condition and species group

BY FOREST CONDITION

Forest condition and species group	Volume on commercial areas			Volume on noncommercial areas			Total volume	
	Saw timber (Scribner rule)		Cordwood ¹	Saw timber (Scribner rule)		Cordwood ¹	Saw timber (Scribner rule)	Cordwood ¹
	In high-grade logs	In low-grade logs		In high-grade logs	In low-grade logs			
Old growth:	<i>M board feet</i>	<i>M board feet</i>	<i>Cords</i>	<i>M board feet</i>	<i>M board feet</i>	<i>Cords</i>	<i>M board feet</i>	<i>Cords</i>
Uncut.....	964,800	878,100	723,800	61,200	1,401,600	1,116,900	3,305,700	1,840,700
Partly cut.....	324,800	347,100	376,600	102,400	1,454,200	1,654,900	2,228,500	2,031,500
Second growth:								
Sawlog size:								
Uncut.....	825,900	778,000	1,020,000	173,300	1,042,200	2,128,200	2,819,400	3,148,200
Partly cut.....	46,300	75,200	102,100	33,300	351,800	720,500	506,600	822,600
Under sawlog size.....				25,300	259,800	1,692,500	285,100	1,692,500
Reproduction.....					7,100	15,800	7,100	15,800
Clear-cut.....					9,700	24,200	9,700	24,200
Nonproductive.....					300	3,500	300	3,500
Total.....	2,161,800	2,078,400	2,222,500	395,500	4,526,700	7,356,500	9,162,400	9,579,000

BY SPECIES GROUP

Red gum.....	543,500	382,600	313,400	66,300	360,000	1,007,400	1,352,400	1,320,800
Water oaks.....	302,800	442,200	165,300	33,500	942,700	697,300	1,721,200	862,600
Red oaks.....	5,000	10,800	10,300		26,700	101,600	42,500	111,900
White oaks.....	12,400	15,900	19,300	8,400	62,500	170,200	99,200	189,500
Overcup oak.....	101,100	239,000	108,200	14,700	1,131,700	562,600	1,486,500	670,800
Ash.....	103,600	79,300	332,700	67,500	95,800	687,500	346,200	1,020,200
Cottonwood.....	232,800	168,900	73,000	16,500	111,700	160,700	529,900	233,700
Willow.....	240,400	197,900	83,600	15,400	126,400	285,200	580,100	368,800
Elms ²	96,100	145,500	292,800	48,300	402,200	906,500	692,100	1,199,300
Tupelo gum ³	103,100	89,600	77,700	900	35,300	44,500	228,900	122,200
Cypress.....	158,100	16,300	37,200	37,300	40,000	70,100	251,700	107,300
Bitter pecan.....	107,100	133,100	157,000	27,200	779,600	919,700	1,047,000	1,076,700
Sweet pecan ⁴	47,900	28,000	69,900	18,900	81,300	238,900	176,100	308,800
Hackberry.....	52,400	62,500	289,600	17,100	166,700	719,700	298,700	1,009,300
Pines.....	8,800	3,600	3,400	15,900	10,900	67,100	39,200	70,500
Miscellaneous.....	46,700	63,200	189,100	7,600	153,200	717,500	270,700	906,600
Total.....	2,161,800	2,078,400	2,222,500	395,500	4,526,700	7,356,500	9,162,400	9,579,000

¹ Cordwood volume of trees under sawlog size, which includes the wood and bark of the main stem to a usable top. The minimum allowable top was never less than 4 inches and seldom more than 8. Cordwood volume was calculated on a basis of 80 cubic feet per cord for hardwood species and 90 cubic feet for pine and cypress. Only woods *cull* was deducted from cordwood volume.

² Of the total elm volume, approximately 51 percent is cedar elm, 42 percent white elm, and 7 percent winged and red elm.

³ Approximately 33 percent of this volume is black gum.

⁴ Approximately 23 percent of this volume is hickory.

small part of the total high-grade volume, less than 400 million board feet, is found on noncommercial forest areas.

Four species groups show total net volumes of more than 1 billion board feet each (fig. 7 and table 7). Water oaks lead with almost 1¾ billion board feet, overcup oak is second, and red gum and bitter pecan follow in order. Of the total volume of 9 billion board feet, 28 percent is in high-grade logs. This volume of high-grade material is distributed among the species as shown in figure 7.

Considering total board-foot volumes by species on commercial forest areas, red gum leads with over 900 million board feet. The water oaks, willow, cottonwood, overcup oak, and elms follow in order.

Cordwood Volume

In addition to saw-timber volume, living trees, both sound and cull, contain approximately 31 million standard cords (4 by 4 by 8 feet) of sound wood not suitable for saw timber. This cordwood

volume includes bark and is classified as follows:²

Stem wood of good trees under sawlog size	Cords
(table 7).....	9,579,000
Tops and limbs of good trees of sawlog size....	15,512,500
Stems, tops, and limbs of sound cull trees....	5,000,000
Sound portion of stems, tops, and limbs of rotten cull trees.....	875,000
Total.....	30,966,500

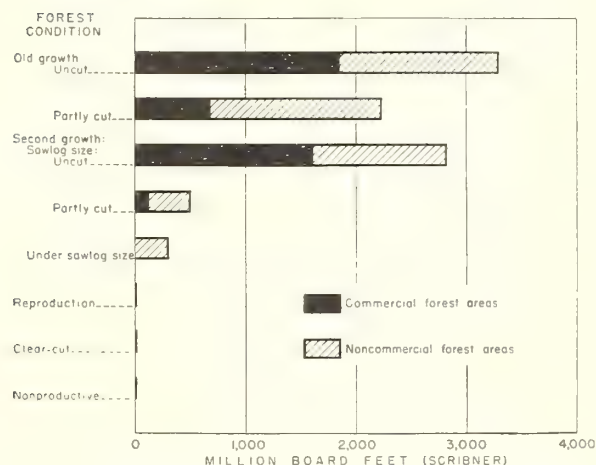


FIGURE 6.—Net board-foot volumes on commercial and noncommercial forest areas in the different forest conditions

The cordwood volume in trees under sawlog size does not include the volume of limb wood. In sawlog-size trees the volume includes that portion of the main stem above the usable sawlog limit defined on page 20 and also the volume of all hardwood limb wood over 4 inches in diameter. In sound cull trees, the volume includes the total volume of all stem wood in trees over 5 inches and limb wood in trees of sawlog size. In rotten cull trees the volume includes all sound stem wood in trees over 5 inches and limb wood in trees of sawlog size.

PULPWOOD AND CHEMICAL-WOOD VOLUMES

Although the volume of wood now being manufactured into pulp is limited to small quantities of pine and cottonwood (converted into kraft paper and fiberboard, respectively), a large supply of pulpwood is available in the unit. Table 8 shows that there are 10 million cords in stems of pulping hardwoods and pines. This table is a conversion

² Estimates as given here, of cordwood volume in tops and limbs of sawlog-size trees and in the sound portion of cull trees are only approximate.

into cords of the total stem-wood volume of the stand, including saw timber already covered in other tables. It does not include material in tops of sawlog-size trees or in sound and rotten cull trees.

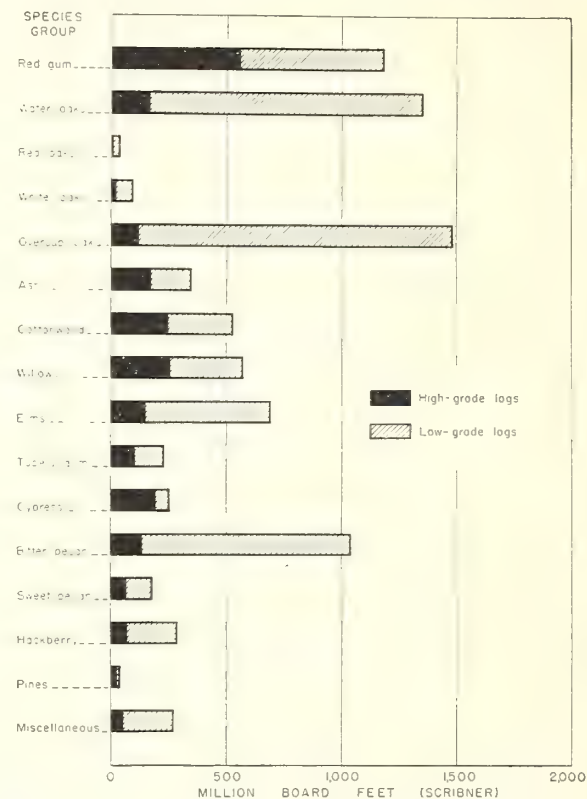


FIGURE 7.—Net board-foot volumes, classified according to log grade and species group

The figures in table 8 include the volume of saw timber and cordwood shown in table 7 classified in cords on the basis of adaptability for pulping processes. In addition to this volume, there is in the survey unit approximately 7 million cords (one-third of the 21 million cords listed on above) in tops of good trees of sawlog size, sound cull trees, and sound parts of rotten cull trees of pulping species. On account of crook, crotch, and general form, however, it is impracticable to work up all of this material for pulpwood.

Cottonwood and willow are at present the most economically available for pulping because both occur in relatively heavy pure stands and, except for most of such willow as occurs in swamps, are nearly always accessible to water transportation. The other pulping hardwoods are widely distributed throughout the unit mixed with nonpulping species.

TABLE 8.—*Net cordwood volume¹ in stems of good trees classified according to species group and diameter-class group*

Species group	6-12 inches	14-18 inches	20+ inches	All diameters	
	<i>Cords</i>	<i>Cords</i>	<i>Cords</i>	<i>Cords</i>	<i>Percent</i>
Cottonwood.....	233,700	449,200	844,600	1,527,500	4.4
Willow.....	368,800	703,400	906,600	1,978,800	5.7
Other pulping hardwoods ²	1,660,300	1,819,100	3,014,500	6,493,900	18.9
Pine.....	134,400	31,000	7,800	173,200	.5
All pulping woods.....	2,397,200	3,002,700	4,773,500	10,173,400	29.5
Nonpulping hardwoods.....	7,153,600	6,512,800	10,667,000	24,333,400	70.5
All woods.....	³ 9,550,800	9,515,500	15,440,500	34,506,800	
Total percent.....	27.7	27.6	44.7		100.0

¹ Volume includes bark to approximately a 4-inch top for under sawlog-size trees, and to a sawlog top for sawlog-size trees.

² Red gum, tupelo gum, black gum, maple, boxelder, and cypress.

³ The difference between this figure and the cordwood volume in stem wood of good trees under sawlog size shown in table 7 and elsewhere is due to the fact that in those instances the total volume of persimmon, regardless of tree size, has been included in the cordwood volume.

Of nonpulping species, there is, in addition to the more than 24 million cords in stems of good trees, the remaining 14 million cords in tops of good trees of sawlog size, sound cull trees, and the sound parts of rotten cull trees. Of the aggregate volume of nonpulping material, 80 to 90 percent is in kinds of wood generally considered suitable for destructive distillation; but a large part of this is in overcup oak, bitter pecan, and other species of low or undetermined value for this purpose.

VOLUME OF WOOD FOR HANDLES AND SPECIALTIES

Table 9 reclassifies that portion of the volume of certain species (table 7) that is suitable for manufacture into handles and athletic goods. In general, trees of these species occur singly or in

TABLE 9.—*Net volume of material suitable for handles and athletic goods*

Species	Trees 9-12.9 inches d. b. h.	Trees 13 inches and over d. b. h.	All trees 9 inches and over d. b. h.	
	<i>Cords</i>	<i>Cords</i>	<i>Cords</i>	<i>Percent</i>
Persimmon.....	149,200	131,000	280,200	25.8
Ash.....	256,600	514,900	771,500	71.1
Hickory.....	14,000	19,100	33,100	3.1
Total.....	¹ 419,800	² 665,000	1,084,800	100.0

¹ 38.7 percent of total.

² 61.3 percent of total.

small patches throughout the forest. For this use high-grade logs or bolts are required; but if of ash and hickory, they may be as small as 8 inches, and if of persimmon, 6 inches in diameter. No attempt was made to classify ash on the basis of texture. Although it is thought that the ash will run largely to firm or better, a considerable volume is known to be brash. Neither has an attempt been made to classify the persimmon on the basis of width of sapwood.

Cubic-Foot Volume

The figures for cubic-foot volume cover the total sound content (inside bark) of all live trees, including hardwood tops and limbs larger than 4 inches in diameter. This volume, therefore, comprises the classes of material covered in the cordwood estimate plus the cubic volume of good trees of sawlog size. This total cubic volume is as follows:

	<i>Million cubic feet (inside bark)</i>
Stem wood of good trees (both sawlog size and under sawlog size).....	2,360.0
Top wood of good trees of sawlog size, including limbs.....	994.4
Stems, tops, and limbs of sound cull trees.....	334.4
Sound portion of stems, tops, and limbs of rotten cull trees.....	59.1
	3,747.9

Timber Increment

CURRENT net increment, as considered in this report, is the difference between the net volume of live good trees standing in the unit January 1, 1934, and the corresponding volume that, according to Forest Survey estimates, would have been standing on January 1, 1935, if there had been no volume removed in cutting during the year. It is the increase over and above the volume lost through natural mortality. The board-foot loss through natural mortality is equal to approximately four-fifths of the net board-foot increment and the

corresponding cubic-foot loss is equal to approximately 85 percent of the net cubic-foot increment.

Board-Foot Increment

Board-foot increment comprises two elements (1) the growth on trees already of sawlog size and (2) the total board-foot volume of trees coming into sawlog size during the year. This increment is expressed in net woods scale, that is, the gross scale of usable sawlogs. It is based on good trees only, and

TABLE 10.—Total woods net annual increment (Scribner log scale) ¹ classified according to forest condition

Forest condition	Increment ² in trees remaining under sawlog size		Increment in trees growing into sawlog size		Increment in trees of sawlog size		Total increment		
	Com- mercial area ³	Noncom- mercial area	Com- mercial area ³	Noncom- mercial area	Com- mercial area ³	Noncom- mercial area	Com- mercial area ³	Noncom- mercial area	All areas
Old growth:	<i>Cords</i>	<i>Cords</i>	<i>M board feet</i>	<i>M board feet</i>	<i>M board feet</i>	<i>M board feet</i>	<i>M board feet</i>	<i>M board feet</i>	<i>M board feet</i>
Uncut.....	12,280	4,460	4,100	8,810	7,490	2,020	11,590	10,830	22,420
Partly cut.....	—40	9,400	2,050	12,070	10,680	590	12,730	12,660	25,390
Total.....	12,240	13,860	6,150	20,880	18,170	2,610	24,320	23,490	47,810
Second growth:									
Sawlog size.....	—48,260	1,240	9,260	30,920	98,880	870	108,140	31,790	139,930
Under sawlog size.....		21,170		25,810		—2,930		22,880	22,880
Total.....	—48,260	22,410	9,260	56,730	98,880	—2,060	108,140	54,670	162,810
Clear-cut and reproduction.....		4,580		110		140		250	250
All conditions.....	⁴ —36,020	40,850	15,410	77,720	117,050	650	132,460	78,410	210,870

¹ Increment figures are based on the assumption that no cutting takes place.

² This volume increment includes the annual growth on trees 5 inches and larger in diameter, but under sawlog size, plus the volume (in cords) of trees that during the year move into the 6-inch diameter class.

³ The annual increment on commercial forest areas includes not only the increment on areas that were commercial forest at the beginning of the year, but also the total timber volume added on commercial forest areas through the movement of areas from the noncommercial to commercial class as a result of 1 year's growth. Negative board-foot increment on noncommercial forest indicates (1) that the volumes on areas moving from the noncommercial to the commercial class were greater than the increment on areas remaining in the noncommercial class, and (2) that the mortality in residual stands is heavy.

⁴ Negative annual cord-volume increments of trees under sawlog size may mean one of two things (or both): (1) Either the volume of trees moving from under sawlog size to sawlog size is greater than the increment in cords of the trees that were under sawlog size at the beginning of the year (see footnote 2); or (2) the volume in cords on areas moving from the noncommercial to the commercial class is greater than the increment on areas that remain in the noncommercial class.

from these trees excludes woods cull, that is, those rotten, crooked, and crotched stem sections which ordinarily are left in the woods. It does, however, include such cull as shake, sweep, and rot that is ordinarily taken to the sawmill.

On the basis of the net woods scale, the total 1934 increment was nearly 211 million board feet, Scribner rule (table 10). Of this total, 93 million board feet or approximately 44 percent is accounted for by the volume of small trees becoming of sawlog size during the year. A substantial part of the remainder grew on trees that were in the 14- to 18-inch diameter classes at the beginning of the year. Nearly 66 percent of the total increment was on the second-growth sawlog-size areas, while only 10 percent was on the old-growth uncut area. Nearly 63 percent, or 132½ million board feet, occurred on commercial forest areas. This includes the total volume on areas which entered the commercial classification during the year as a result of increases in volume and improvement in quality of the trees.

Table 11 shows the average annual increment per acre in 1934 on commercial and noncommercial areas in the various forest conditions. The weighted average increment expressed in net woods scale for all types and conditions in the entire forest area was 78.6 board feet per acre; the average annual increment for the overcup oak-bitter pecan type, where growth conditions are generally the least favorable, amounted to only 42.5 board feet per acre.

The board-foot increment per acre is substantially greater in the second-growth sawlog-size condition than in any other forest condition. In second-growth, sawlog-size stands the annual increment per acre on commercial areas is half again as large as that on noncommercial areas. By contrast, in old-growth uncut stands the annual increment per acre on commercial areas is about one-third of that on noncommercial areas. This large difference between old-growth and second-growth stands is chiefly due to the preponderance of over-ripe, decadent timber in the former, whereas the difference in the rate of growth on commercial and noncommercial areas of similar condition is largely due to differences in stocking.

TABLE 11.—*Woods net annual increment¹ per acre classified according to forest condition and general type group*

Forest condition	Mixed hard-wood ²		Overcup oak-bitter pecan		All types	
	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet
Commercial area:						
Old growth, uncut.....	17.2	7.5	20.1	6.6	17.9	7.3
Old growth, partly cut.....	4.4	6.5	5.4	3.0	4.6	5.9
Second growth, saw-log size.....	236.9	39.9	130.6	20.0	233.7	39.3
Noncommercial area:						
Old growth, uncut.....	47.5	13.0	50.3	9.5	49.9	10.0
Old growth, partly cut.....	51.0	11.5	29.5	5.4	42.0	8.9
Second growth, saw-log size.....	153.1	26.7	69.8	18.6	140.5	25.5
Second growth, under sawlog size.....	61.1	26.2	52.0	9.9	59.9	24.0
Clear-cut and reproduction.....	2.2	2.0	1.1	0	1.7	1.6
All conditions.....	94.3	20.7	42.5	8.7	78.6	17.1

¹ The increments per acre represent the difference between the average volume per acre in the given forest type and condition at the beginning and end of the growing season. Natural mortality is accounted for, but not cutting. Board-foot volumes are Scribner log scale. Cubic-foot increment represents the growth of sound stem wood, excluding bark; in good trees at least 5 inches in diameter, plus the total volume of small trees growing up to and exceeding this diameter during the year.

² Includes all types mentioned in table 5 except overcup oak-bitter pecan.

³ Negative increments occur where the volume lost to the stand through natural mortality is greater than the annual increment.

Cordwood Increment

In addition to the saw-timber increment, there are approximately 419,000 cords of annual increment in material suitable for cordwood only. The composition of this total cordwood increment is as follows, the last three items being approximations only:

	Cords
Stem wood of good trees under sawlog size.....	5,000
Top wood of good trees of sawlog size.....	300,000
Stems and tops of sound cull trees.....	97,000
Sound portion of stems and tops of rotten cull trees.....	17,000
Total.....	419,000

The cordwood increment of good trees under sawlog size is surprisingly small because of the large proportion of them which move into sawlog size.

Cubic-Foot Increment

The cubic foot is a unit of measurement applicable to all the material in the forest. The aggregate net cubic-volume increment (excluding bark) for 1934 is approximately 71 million cubic feet, made up as follows:

	Million cubic feet (without bark)
Stem wood of good trees (both sawlog size and under sawlog size).....	44.83
Top wood of good trees of sawlog size (including limbs).....	18.89
Stems and tops of sound cull trees.....	6.36
Sound portion of stems and tops of rotten cull trees.....	1.12
Total.....	71.20

Considering the forest as a whole, the average net annual increment per acre in stem wood of good trees is 17.1 cubic feet. This average increment varies on commercial areas between approximately 6 cubic feet per acre in the old-growth, partly cut condition and 39 cubic feet in the second-growth, sawlog-size condition. On the noncommercial areas the cubic-foot increments are somewhat greater in the old-growth condition and somewhat less in the second-growth condition.

Again considering the forest as a whole, the average net cubic-foot increment per acre of sound material in stem wood, top wood, and sound and rotten cull trees is approximately 27 cubic feet. This average growth per acre is low because of (1) large areas of slow-growing, overmature, old-growth timber; (2) prevalence of understocked stands; (3) an unusually large proportion of slow-growing species such as overcup oak, bitter pecan, cedar elm, and hackberry; and (4) a large number of relatively nonproductive sound and rotten cull trees. Under even a very simple system of forest management these conditions could be improved and the average cubic-foot increment increased.

Diameter Growth

The current rate of diameter increase was measured on approximately 4,000 trees of all species uniformly scattered throughout the unit. Table 12 gives the average 10-year increase in

diameter for important species groups and diameter-class groups, with a summary by different forest conditions. Although the average 10-year diameter increase for all species and conditions is in the neighborhood of 2 inches, individual species vary considerably from this average. Cottonwood, willow, red oaks, and water oaks grow conspicuously faster than the average; while overcup oak, elms (due chiefly to the large proportion of cedar elm), black gum, bitter pecan, hickory, and hackberry are notably slow growers.

Table 12 furnishes a basis for an approximate estimation of the diameter growth to be expected in any southern bottom-land hardwood forest, the composition of which is known by conditions, species, and sizes.

TABLE 12.—Average diameter growth in 10 years of the various species groups and diameter-class groups

Species group and forest condition	Growth in diameter-class group of—			
	6-12 inches	14-18 inches	20-28 inches	30+ inches
	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>
Red gum.....	2.12	2.18	2.02	1.49
Water oaks.....	2.57	3.14	2.80	2.09
Red oaks.....	3.62	3.05	3.93	1.70
White oaks.....	2.35	1.92	1.79	1.80
Overcup oak.....	1.52	1.71	1.37	1.35
Ash.....	1.52	2.03	1.55	1.16
Cottonwood.....	4.31	3.29	3.59	3.18
Willow.....	2.84	4.18	3.65	2.85
Elms.....	1.48	1.59	1.62	2.21
Tupelo gum.....	2.13	2.62	2.42	.....
Black gum.....	1.44	1.80	1.57	1.98
Cypress.....	1.71	2.01	2.23	.90
Bitter pecan.....	1.45	1.46	1.53	1.70
Hickory.....	1.68	1.33	1.50	.....
Sweet pecan.....	1.92	2.73	2.08	2.25
Hackberry.....	1.57	1.55	1.47	.....
Pine.....	2.38	2.80	3.00	.....
Persimmon.....	1.48	1.23	2.23	.....
Red maple and boxelder.....	1.57	3.12	2.32	3.20
Other hardwoods.....	2.48	2.23	2.00	2.27
Weighted average.....	1.90	2.15	2.04	1.77
Summary by forest conditions:				
Old growth, uncut.....	1.49	1.45	1.42	1.64
Old growth, partly cut.....	1.68	1.75	1.91	1.86
Second growth:				
Sawlog size:				
Uncut.....	1.89	2.64	3.00	2.35
Partly cut.....	1.77	2.79	2.58	2.80
Under sawlog size.....	2.55	2.37	2.22	1.84
Weighted average.....	1.90	2.15	2.04	1.77

Forest Products Industries

IN 1934 the north-Louisiana delta supported 59 forest industrial plants within its boundaries (fig. 8). Of these, 40 were sawmills. Of the 19 other wood-products plants, 10 produced tight-cooperage stock, 3 produced slack-cooperage stock, 2 were veneer mills, 2 were small shingle mills, 1 was a pulp mill, and 1 a specialty plant. In addition, 4 sawmills, 3 veneer plants, 1 slack-cooperage plant, and 1 specialty plant located outside the survey unit were supported in part during 1934 by timber cut within the unit. Also, 9 sawmills, 4 slack-stave mills, 3 veneer plants, and 1 pulp mill lying still farther away and not shown in figure 8 drew some raw materials from the forests of the unit.

Lumber Industry

At the sawmills two distinct general classes of hardwood products are manufactured—industrial lumber and structural material. The former is lumber produced and marketed under standard grades which express the relative utility of the raw material for manufacturing industries, particularly for the manufacture of furniture, fixtures, vehicles, flooring, millwork, and implements. Hardwood sawmills, producing industrial lumber principally are in general of medium size to large (at least 15,000 to 20,000 feet capacity per day). They are usually band mills equipped to produce well-manufactured, rough, air-dried lumber. Since the manufacturing industries have always done a major part of their own kiln-drying, resawing, and surfacing, only a small part of the total production of industrial lumber is subjected to these processes at the sawmill.

Hardwood structural material is chiefly of two types: (1) Heavy railroad material, including cross ties, car stock, and dock and bridge stock; and (2) common light structural lumber for local and neigh-

borhood use. Hardwood sawmills producing structural material chiefly are usually of medium size to small (less than 15,000 to 20,000 feet daily capacity). They are commonly circular mills and do not have the facilities necessary for the proper edging, trimming, and yarding of their entire output.

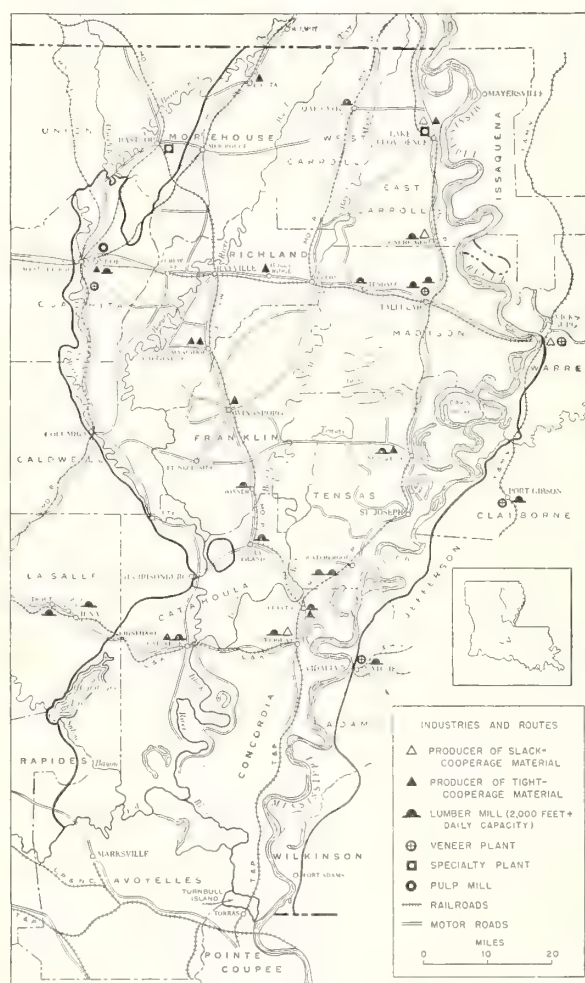


FIGURE 8.—Forest industries and transportation systems in the north-Louisiana delta

TABLE 13.—*Production and employment data in the lumber industry, 1934*¹

Daily mill capacity (M board feet)	Mills	Total annual capacity	Mill production	Mill employment	Woods cut	Woods employment
	<i>Number</i>	<i>M board feet</i>	<i>M board feet</i>	<i>Man-days</i>	<i>M board feet</i>	<i>Man-days</i>
1-4.....	9	2,600	500	800	500	700
5-9.....	13	11,000	1,100	1,700	1,100	1,400
10-19.....	4	11,000	1,400	2,100	1,700	1,900
20-39.....	5	48,400	11,600	24,100	16,300	23,200
40-79.....	9	160,700	59,400	125,400	88,400	114,000
Total.....	40	233,700	74,000	154,100	108,000	141,200

¹ Based on a 10-hour operating day and net log scale (Doyle) at the mill, according to commercial scaling practice. No mills of 80 M board feet capacity or larger.

The hardwood sawmills of the United States produce mostly industrial lumber. The relative importance of the two classes of products, however, varies greatly with the locality. Mills producing chiefly industrial lumber tend to move into areas having sufficient timber of high quality—yielding at least an average of 50 to 60 percent No. 1 common or better lumber—to warrant operation. This survey unit contains perhaps more uncut old-growth hardwood timber than any other equal area in the United States, which accounts for the fact that over 95 percent of the material produced in the sawmills of the unit is from industrial lumber mills.

The 74 million board feet¹ of logs manufactured into lumber in 1934 (table 13) by the 40 sawmills (including a very small volume of pine lumber) was approximately 30 percent of the rated plant capacity. Nearly all of the logs from which this lumber was cut came from the forests of the north-Louisiana delta. The 154,000 man-days of mill labor required to produce the lumber, on a basis of 200 working days per year, represented full-time employment for about 770 men. As a matter of fact, owing to the amount of part-time employment in a number of the smaller mills, a larger number of individuals were actually employed. The item of mill labor includes labor in the mill proper, in the office, and in the yard and loading.

The difference between the 108 million board feet of logs (Doyle scale) actually removed from the forests of the unit for lumber production in 1934 and the 74 million board feet of sawmill production

represents approximately the volume of logs cut from the forests of the unit and shipped to sawmills elsewhere. The 141,000 man-days of woods labor required to produce this total volume of logs was equivalent to full-time employment for over 700 men. "Woods employment" covers all steps in the operation from the stump to delivery at the sawmill, except common-carrier service.

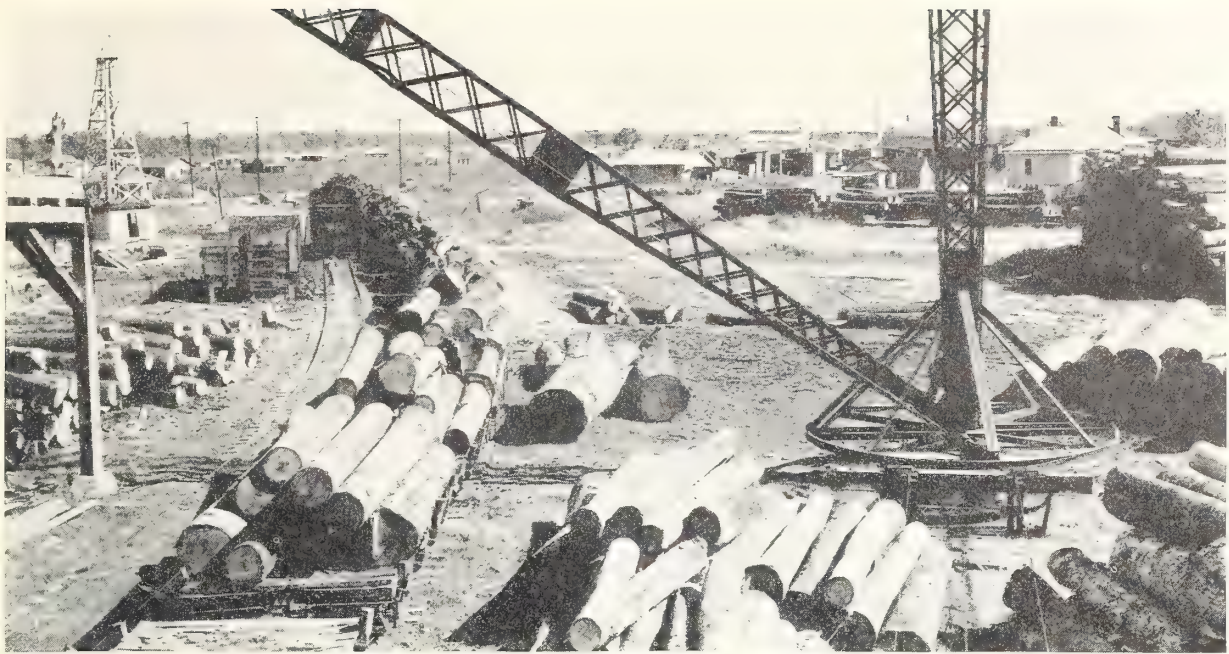
Lumber-mill labor in this unit is supplied by full-time professional sawmill workers plus a small proportion of transient common labor. Woods labor is also largely supplied by full-time professional woods workers. With the development of truck logging, however, an increasing proportion of the logging work is done by part-time contractors, who may alternate between logging and other forms of public work.

In the Mississippi River Delta conditions are favorable for logging all year except for 3 to 5 months during the season of winter rains. Even during the winter, logging is possible on the better drained, more accessible situations.

Until recently, mule teams and eight-wheel wagons were commonly used to transport logs from the stump to the railroads, and in some few cases, directly to the sawmill. Since 1925, motortrucks have become very important in moving logs from the woods to the common carrier and in many cases directly to the mill, thus often supplanting both the logging railroads and, under favorable conditions, the eight-wheel wagons. Although mules still serve for bunching and loading, tractors are now being successfully introduced to replace the mules, and caterpillar-tread wagons are now beginning to supplant the eight-wheel wagons.

Since early times there has been and probably there always will be some rafting and barging of logs on the principal streams; and much of the

¹ Net Doyle log scale. Throughout the discussion of forest-products industries the Doyle log scale is used because it is the one used by operators in this territory. Furthermore, practically all forest-production statistics for the delta hardwoods are shown in this scale.



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FIGURE 9.—Log yard of an industrial lumber mill, showing the general class of logs removed from old-growth timber. Madison Parish, La.

volume of logs moved out of the unit is transported in this way. Logs are generally moved to the riverbanks by the same means used in moving logs to the common carrier. Once on the river, they may be rafted or barged as far as 100 to 150 miles to the mill.

In general, industrial lumber mills do not cut trees smaller than 18 to 20 inches in diameter (fig. 9). Only the higher quality trees of the standard commercial species are cut in the diameter classes between 20 and 28 inches. In trees more than 30 inches in diameter, practically all clean, sound stems of the more valuable species are cut, while in the less desirable species only the very best trees are cut. At worst, this kind of partial cutting leaves the woods in a satisfactory condition for reproduction; more often industrial lumber-mill cuttings leave a partial stand of thrifty young sawlog-size trees, which in 15 to 25 years will grow into size and quality that will justify a second cut for industrial lumber.

Nonlumber Industries

Although the other forest industries used only about 60 percent as much wood from the forests of the unit as the lumber industry, they supplied more

than half again as much employment. Furthermore, these nonlumber industries are particularly significant because of the likelihood of their expansion as stands cut over in lumber production become available for stove cuttings, veneer cuttings, etc. Table 14 shows the production and employment of the nonlumber industries.

The nonlumber industries supplied more than 450,000 man-days of labor in the woods and mill in 1934. On the basis of 200 working days per year, these industries provided the equivalent of full-time employment for about 2,250 persons.

It is estimated that a gross volume of about 270,000 cords of wood is drawn from the forest for fuel and other home uses. Probably not more than 10 percent of this enters into trade, but its production and use are nevertheless important factors in the local economic life of the people. The material thus obtained, without cash outlay and without interference in normal gainful employment, is a substitute for material that would otherwise have to be purchased. One way of expressing the importance of this material is in terms of the labor necessary in its cutting and transportation; for the unit as a whole this amounts to approximately 350,000 to 400,000 man-days.

TABLE 14.—*Production and employment data in the nonlumber industries in 1934*¹

Material produced	Plants in unit	Total annual capacity	Plant production	Plant employment ²	Woods cut	Woods employment
	<i>Number</i>	<i>Cords</i>	<i>Cords</i>	<i>Man-day</i>	<i>Cords</i>	<i>Man-day</i>
Tight-cooperage stock ³	10	62,900	40,600	57,200	40,600	49,300
Slack-cooperage stock ⁴	3	20,000	13,300	26,500	23,100	21,200
Pulp.....	1	(⁵)	(⁵)	(⁵)	2,400	2,400
		<i>M board feet</i>	<i>M board feet</i>		<i>M board feet</i>	
Rotary veneer.....	2	9,000	4,800	33,600	14,700	19,900
Specialties.....	1	(⁵)	(⁵)	(⁵)	4,000	7,200
Export logs and staves.....					1,500	4,600
Shingles.....	2	400	100	500		200
					<i>Pieces</i>	
Cross ties.....					167,900	20,000
Poles and piles.....					1,300	400
Total.....	19			8330,700		125,200

¹ Board-foot measure is Doyle log scale, net, according to commercial scaling practice. The standard cord is 4 by 4 by 8 feet including bark. Man-days are 10 hours.

² Includes only employment afforded by primary production; does not include employment in secondary manufacture such as stave finishing, millwork, furniture, box, plywood, and container manufacturing.

³ Includes staves and heading.

⁴ Includes staves, heading, and hoops.

⁵ Specific information for individual operations cannot be shown; to do so would reveal confidential information.

⁶ Total plant employment including pulp and specialty production.

INDUSTRIES REQUIRING HIGH-GRADE MATERIAL

In general, the manufacture of veneer, slack- and tight-cooperage stock, poles and piles, export stock, and specialties—such as blanks for baseball bats, plugs for paper rolls, shuttle blocks, and athletic goods—requires a high proportion of high-grade logs. These industries, with the possible exception of export logs and certain classes of veneer, ordinarily draw on the high-grade material in second-growth stands and residual stands left after lumber-mill logging. They can operate in such timber because (1) they can use timber of smaller average size or slightly lower average quality than that required by the lumber industry; (2) some of the industries, notably those producing slack-cooperage material and package veneer, regularly use species which are not utilized closely, if at all, by the lumber industry; and (3) some industries, particularly those producing cooperage materials and specialties, can use raw material in the form of bolts and billets, thus minimizing the

equipment and skill required in logging. This permits the utilization of short and crooked clear lengths not adapted to the production of industrial lumber and also permits the logging of scattered timber on the basis of individual trees.

In general, logging methods for veneer and export logs are the same as for lumber-mill logging; in fact a large part of it is carried on in conjunction with lumber-mill logging. The net effect on the residual stand is essentially the same, except that where package veneer is cut, a sparser and inferior stand results.

Tight- and slack-cooperage material, specialty stock, and export stave and handle stock are usually logged in the form of bolts and billets, or occasionally of small logs. Since this type of logging requires a minimum of equipment and a maximum of manual labor, it is commonly done by farmers and other part-time woods workers rather than by professional loggers. Transportation of material from woods to mill is usually provided by farmers with teams and by local truckers and contractors. No trees smaller than 12 to 14 inches in diameter are used. After a cutting of this kind, the supply of high-grade industrial raw material is practically exhausted for the time being; but there is commonly a substantial volume of low-grade saw timber suitable for the production of cross ties and of common structural material by small sawmills.

Practically the entire production of poles and piles is made up of cypress selected tree by tree from dense stands of second growth scattered throughout the unit. This type of logging is done almost entirely by part-time contractors or jobbers.

INDUSTRIES THAT CAN USE LOW-GRADE MATERIAL

The shingle, pulp, and tie industries, because they do not require high-grade material, can operate still more effectively than the other nonlumber industries on the kind of timber most abundant in residual and second-growth stands. This material is usually logged in special short lengths. During the past few years most of the cross ties have been hewed in the woods; though formerly most of them were sawed by small portable sawmills.

Logging is usually carried on in good residual or second-growth stands, with special regard to species and soundness of material but without particular regard to quality, the methods being essentially

similar to those used in the production of cooperage material and similar products. Although high-grade material has no special value for these purposes, it is generally used indiscriminately wherever found. After a cutting for these products, the stand is very largely reduced to saplings, small poles, and cull trees, except for larger trees of species

not used for cross ties, pulp, or shingles. Cypress is the only species used for shingles; cottonwood, pine, and occasionally willow are the only ones used for pulp; and oaks (excepting overcup), cypress, and the gums are practically the only species used for cross ties.

Comparison of Forest Growth and Drain

THE total amount of wood taken from the forest of the unit in 1934 for use in industry and for domestic purposes has been converted into terms of drain against the growing stock of timber in the same year. Forest drain, as the term is used here, means the total volume of usable material removed from the stands by cutting, including the full volume of the trees felled, but not including losses from such natural causes as shading, windfall, and disease. This drain in board-foot material thus includes the volume actually used plus the volume left on the ground in the woods as waste because it did not meet the requirements of the particular user, although it met the Survey specifications for usable logs.

Table 15 shows the amount of timber actually used in the production of the various commodities during 1934 and the resulting drain against the growing stock of good, live trees of sawlog size. This drain is for a depression year and does not necessarily represent present or future annual drain. All evidence, in fact, indicates that the drain in the years of recovery since 1934 has been

greater and probably will continue to be greater until general business conditions change or until some of the large industrial lumber mills cease operation because of lack of timber. Of the total drain of over 285 million board feet, approximately 70 percent comes from commercial forest areas. A particularly high proportion (more than 90 percent) of the cut for lumber and veneer comes from this class of forest. In contrast, less than 10 percent of the board-foot drain occasioned by land clearing and domestic use comes from commercial forest areas, and the saw-timber material cut for these purposes is very largely unsuited to high-grade industrial uses. Table 15 records nearly half the total drain against the saw timber-size trees as accounted for by lumber-mill cuttings. Land clearing was next in importance, followed by the production of materials for tight-cooperage and domestic use.

In addition to the drain of sawlog-size material from the forest of the unit, there is a cordwood drain from the stems of good trees under sawlog size, from the top wood of good trees of sawlog size, and from cull trees. This cordwood drain of material unsuited for saw-timber use is shown in the following tabulation, the last three items being only approximate:

TABLE 15.—*Net volume of timber used and total forest drain from good trees, 1934 (Scribner log scale)*

Kind of material produced ¹	Volume of timber used	Total forest drain
	<i>M board feet</i>	<i>M board feet</i>
Lumber.....	121, 100	137, 000
Rotary veneer.....	16, 800	19, 500
Tight cooperage.....	25, 300	31, 700
Slack cooperage.....	11, 600	13, 600
Specialties.....	4, 600	7, 800
Export stock.....	1, 700	2, 300
Poles and piles.....	300	300
Cross ties.....	5, 700	7, 200
Cut in clearing land.....	37, 500	37, 500
Cut for domestic use.....	28, 600	28, 600
Total.....	253, 200	285, 500

¹ A negligible quantity was also cut for pulpwood.

	<i>Cords (including bark)</i>
Stem wood of good trees (under sawlog size) . . .	148, 000
Top wood of good trees of sawlog size, including limbs.....	436, 600
Stems and tops of sound cull trees.....	104, 800
Sound portion of stems and tops of rotten cull trees.....	14, 000

Total..... 703, 400

The 148,000 cords of drain from the stems of good trees under sawlog size can be further classified according to the purpose for which it was cut: 7,400 cords was cut by industrial operators; 45,800 cords was cut in land clearing; and 94,800 cords was cut for fuel and other domestic uses.

The board-foot drain from commercial forest areas, including both high-grade and low-grade material, expressed in the terms of the international one-fourth-inch log rule (which closely approximates green lumber tally), exceeded the total increment from such areas by 66 percent, or 88 million board feet (table 16). This drain, however, removed mainly high-grade timber of certain species, whereas it is estimated that approximately half the increment was either in low-grade material or in species not utilized by the existing forest industries. It is apparent, therefore, that the drain from commercial areas of material of the grade and species used by forest industries was much more (approximately $3\frac{1}{3}$ times as great) than the increment of the same grade and species on commercial areas.

TABLE 16.—Comparison of board-foot increment¹ with drain in 1934 (International $\frac{1}{4}$ -inch rule)

Item	Commercial area	Total forest area
	Million board feet	Million board feet
Net growing stock, January 1934.....	4,635.4	10,091.4
1934 increment.....	133.3	210.2
1934 drain.....	221.6	321.0
Net growing stock, January 1935.....	4,547.1	9,980.6
Net decrease.....	88.3	110.8

¹ In calculating the increment, appropriate allowance was made for the growth on the volume in trees cut during the year.

TABLE 17.—Comparison of cubic-foot increment¹ (excluding bark) with drain in 1934

Item	Volume in good trees		Volume in sound culls ³	Volume in rotten culls ⁴	Total volume
	Stem wood ²	Top wood			
	Million cubic feet	Million cubic feet	Million cubic feet	Million cubic feet	Million cubic feet
Net growing stock, January 1934.....	2,359.96	994.39	334.45	59.12	3,747.92
1934 increment.....	44.83	18.89	6.36	1.12	71.20
1934 drain.....	51.74	29.50	7.10	.95	89.39
Net growing stock, January 1935.....	2,353.05	983.68	333.71	59.29	3,729.73
Net change.....	-6.91	-10.71	-.74	+ .17	-18.19

¹ In calculating the increment appropriate allowance was made for the growth on the volume in trees cut during the year.

² Includes the cubic contents of the stems of good trees of sawlog size, but does not include the top wood; also includes the main stem of good trees under sawlog size to a variable top, never under 4 inches and seldom over 8.

³ Includes both stem wood and top wood in sawlog- and under sawlog-size trees.

⁴ Includes sound volume in rotten cull trees, both sawlog size and under sawlog size; also includes both sound stemwood and topwood.

For the total forest area, comparison of the board-foot increment and drain shows that drain exceeded increment by 53 percent. When this percentage is compared with the 66 percent for the commercial area, it is evident that commercial forest areas were being depleted at a more rapid rate than the forest as a whole. On the basis of data in table 16 and the statements in the preceding paragraph, it is estimated that the volume of timber of the class actually being cut from commercial areas was depleted approximately 155 million board feet in 1934. Since this figure is greater than the 111 million board-foot depletion of the total forest area by approximately 44 million board feet, the latter figure represents the accretion in timber of a class not then being utilized by the forest industries. Thus, although the total saw-timber volume of the forest was actually being reduced, the growing stock in material that could not be practically utilized by the present forest industries was being built up.

It should be emphasized again that the board-foot increment is net after an allowance for a substantial loss through natural mortality. If it were practicable through improved management to salvage as much as 75 percent of this mortality loss, even without any increase in growth rates, the board-foot increment would balance approximately the 1934 board-foot drain for the total forest.

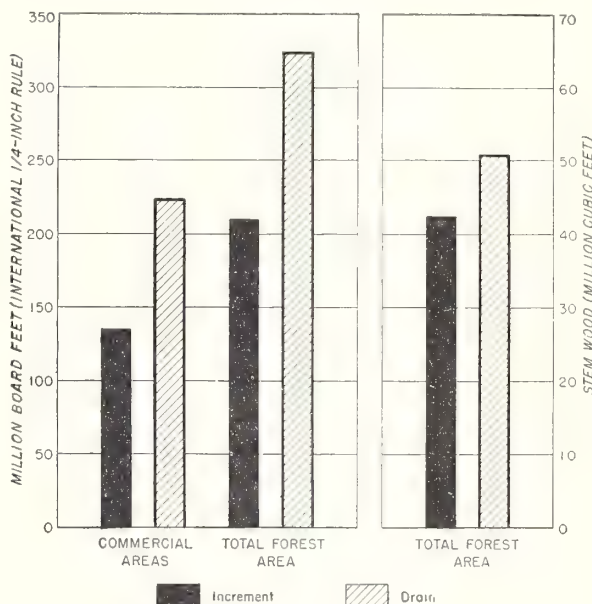


FIGURE 10.—Comparison of increment and drain during 1934

From the standpoint of the total cubic-foot volume of material in the stems of good trees of all sizes, the drain exceeded the increment by almost 7 million cubic feet (table 17). The total cubic-foot drain, including top wood and cull tress, exceeded the increment of comparable material by more than 18 million cubic feet.

Comparison of the increment and drain of stem wood in tables 16 and 17 and figure 10 shows that

in both board feet and cubic feet the drain was greater than the increment. The excess of drain over increment in cubic feet, however, was largely due to the concentration of cutting in the diameter classes above 18 inches. Actually, in under sawlog-size trees and smaller sawlog-size trees the increment in cubic feet exceeded the drain, thus building up the reserve growing stock necessary to replace the present saw-timber inventory.

The Present Situation

FROM a national viewpoint the north-Louisiana delta is of great importance in that it contains one of the most valuable supplies of high-quality old-growth hardwood timber and is one of the most promising areas for the continuous growing of this quality of timber. Although agriculture is the dominant industry, more than 10 percent of the total gainful employment is directly afforded by the forest, either in woods or millwork. The only other important source of employment is the natural-gas industry, which is confined largely to the northwest part of the unit. The forests also supply practically all of the fuel of the country people, a considerable portion of the fuel of the inhabitants of the towns and cities, and most of the posts, palings, shakes, and similar items needed for domestic use throughout the unit. It is estimated that approximately 35 percent of the land tax collected in the unit comes from forest land. In addition, the forest makes important contributions to the local economy by supporting taxable industrial operations.

Growing Stock

At present the forests of the unit are in poor condition for the continuous production of high-quality timber, and present cutting methods are rapidly deteriorating the quality still further. The present rate of timber growth is subnormal because a large part of the available growing space is taken up by cull trees. Furthermore, 22 percent of the forest area bears virgin timber with a high proportion of overmature trees, showing little if any net growth. The greater part of the forest has been overcut and bears too few trees per acre. On these areas this shortage is particularly apparent in the larger diameter classes; in addition, the large trees that are present are in the main of slow growth and are either of poor quality or of species for which no adequate market exists.

Figure 11, *A*, shows the average stand per acre, including virgin forests, the 1934 distribution by diameter classes of the basal area of the growing

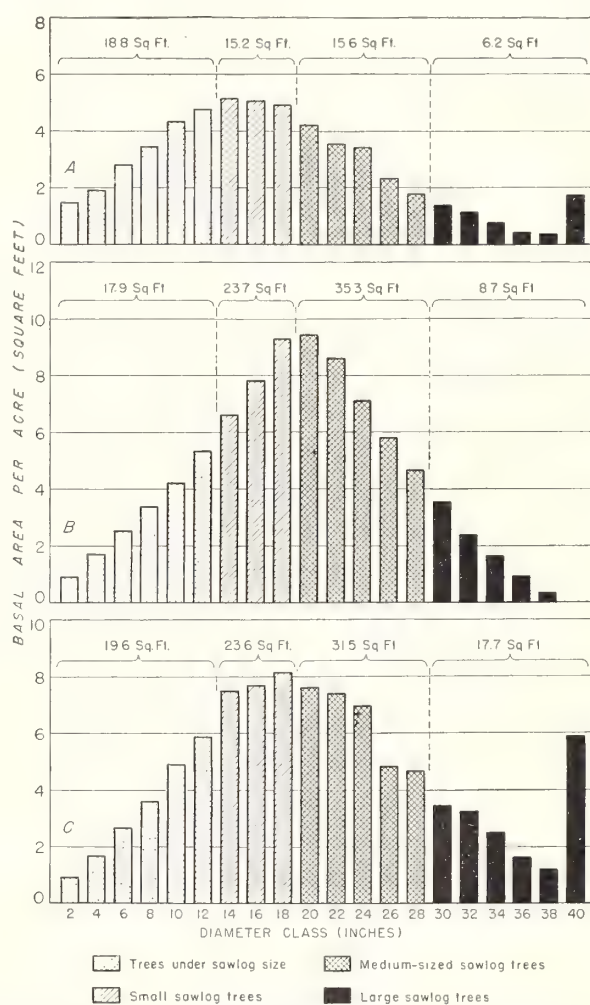


FIGURE 11.—Basal-area distribution per acre of growing stock in good trees: *A*, Distribution (1934) of the entire forest; *B*, attainable optimum of entire forest; *C*, distribution (1934) of commercial forest

stock in good trees. This basal area is the aggregate cross-section area of the stems at breast height. It does not include the basal area of cull trees, which is estimated to be as much as 25 to 30 percent of the basal area in good trees.

Figure 11, *B*, shows the attainable optimum basal-area distribution per acre of bottom-land hardwood forest in the proportions indicated by European experience in forest management as giving the greatest sustained yield under a selective system of management; it represents the averages of areas recently cut over as well as those about to be cut. Comparison of *A* and *B* indicates that (1) in 1934 stands of the unit contained only about two-thirds of the optimum basal area, (2) the most serious shortage was in the diameter classes between 16 and 32 inches, (3) there was no general shortage in the diameter classes from 2 to 12 inches, and (4) there was an excess of timber in trees above 40 inches in diameter owing to a relatively large amount of uncut old-growth timber in the area. This comparison emphasizes the poor condition of the stands, which, if no remedial steps are taken, will continue to deteriorate for some time to come with respect to the distribution of trees among the diameter classes. There is need for a definite course of action to increase the production of these stands and eventually to approach closely the attainable optimum distribution. Specific recommendations for improving the stands will be given on later pages. These recommendations will not be unduly difficult to put into effect. As a matter of fact, the commercial timber area in the survey unit constitutes a substantial nucleus that already, without conscious effort on the part of its owners, approximates this optimum.

Figure 11, *C*, shows the distribution of growing stock on the commercial forest areas of the survey unit. In comparison with figure 11, *B*, the most notable difference is in the excess of large timber on the commercial areas. In most cases the removal of some part of this large timber will actually increase the growth rate of the remainder and place the forest in a better growing condition. Owing to the large number of owner-ships and the many diverse economic circumstances, it is not to be expected that the entire forest area in the unit will be brought up to optimum production for a long time, if ever. There are many areas, however, that easily can be improved now, and for many others

improvement will become possible as economic conditions improve.

Forest Industries

From the preceding pages it is apparent that the industrial organization and practices in this survey unit are adjusted neither to the quantity nor to the quality of the forest growing stock. There are more large plants than can continue to exist on the increment of the growing stock. In 1934, 27 sawmills with a daily capacity of more than 20,000 board feet were operating in or near the unit wholly or in part from timber produced within the unit. Eight of these mills, accounting for approximately 50 percent of the total timber cut for lumber production from the unit in 1934, were operating in large blocks of timber and probably will cease operation when their present timber holdings are cut. Five or six of these planned to operate on their holdings for 6 to 10 years. Two or three expected to "cut out" within 2 or 3 years. These latter perhaps have no alternative but to liquidate at the earliest possible date. The other 19 industrial lumber mills cutting from the unit were either supplementing their cut from their own holdings by purchases of logs and timber or were operating entirely on purchased material and, in the main, may be expected to continue indefinitely.

In 1934, there were 28 nonlumber industrial plants operating on high-grade material from the forests of the unit. The operators of these plants usually purchase logs and small tracts of timber over a wide territory wherever suitable supplies are available. On account of the relatively large supply of suitable raw material thus distributed, probably most of these operators can expect to continue their operations indefinitely. On the other hand, there is no good reason at this time to expect a material increase in the total number of these plants.

From the balance between increment and drain at the 1934 rate of cutting, it would appear that the existing lumber, veneer, and cooperage plants would have a probable life of approximately 15 years; but it is known that the 1934 rate of cutting will not continue and that other pertinent factors also will change. For example, the reduction in number of the large lumber mills mentioned above, together with the resulting improvement in accre-

tion, may possibly extend the life of the remaining industries to as much as 30 years. Furthermore, other less tangible factors—e. g., the use of species or grades not at present used—will in general operate to extend the life of the industries. On the other hand, any increase in the production of

existing individual plants over the 1934 base or the introduction of new ones, as a result of improved economic conditions, will tend to shorten the life of the lumber, veneer, cooperage stock, and other industries requiring high-grade timber.

Possible Future Trends

Forest Industrial Plants

IN THE future, the small sawmills that cut cross ties or structural material will probably increase in relative importance. There is an abundance of timber suitable for this use and at present not otherwise marketable. Much of it is of species generally used, but in trees that have been left standing by the industrial lumber-mill operator because of their low quality. Timber in species now discriminated against might, under improved manufacturing methods and with a growing scarcity of more desirable woods, become quite acceptable for cross-tie or structural use. Relatively efficient mills cutting chiefly structural material are not yet common in the unit, since in the past such material has been largely supplied to the rural markets by the industrial lumber mills from accumulated material of too low grade to warrant shipment to industrial markets. With the passing of some of the large sawmills this source of supply will be greatly reduced throughout the unit and eliminated entirely in some localities. Local agricultural development has probably not reached its peak and a substantial increase in the local demand for cheap building material may therefore be expected. Moreover, when fully equipped mills producing structural material are once established, their product should be able to compete successfully with southern pine and western softwoods. From the standpoint of the national market, it seems likely that hardwoods, in competition with both softwoods and substitutes, will supply an increasing proportion of the heavy structural material. Any general increase of this nature will further increase the relative importance of the small mills cutting this material.

During the past decade there has been developing a pronounced trend within the hardwood in-

dustry toward production at or near the sawmill of rough or semifinished standard industrial parts and of finished special parts. The development of this secondary manufacture in the producing territory makes possible the profitable utilization of timber of a smaller size and a somewhat lower grade than is at present commonly utilized for industrial purposes at greater distances from the mill. It also makes possible a greater local utilization of incompletely manufactured lumber and thus expands the market for the output of small hardwood sawmills, which in the past have been limited chiefly to the production of structural material. This development of the small-dimension industry is of especial significance to the north-Louisiana delta because of the imminent shortage of high-grade timber in this area and the relatively large reserve of marginal timber, for which the small-dimension industry offers the most immediate opportunity for an adequate outlet.

Based upon the available supply of raw material and indications of market requirements, the veneer industry as a whole is likely to maintain itself with but little expansion or contraction during the next decade. Any contraction will take place most probably in the production of the highest grades of commercial and face veneers; whereas, owing to the widening market for plywood, expansion is more likely to develop in the common commercial veneers.

The cooperage-stock industry, as a whole, can be expected to continue without any considerable change during the next decade. Owing to an increasing scarcity of high-grade white oak needed for the production of the higher classes of tight-cooperage stock, the manufacture of these classes may fall off somewhat. On the other hand, the abundance of timber suitable for the production of the common items of slack-cooperage stock indi-

cates the possibility of a local expansion in this industry if the national market improves.

The limited supply of high-quality ash and hickory suitable for the manufacture of such specialties as athletic goods, handles, and vehicle stock precludes the possibility of any considerable local expansion of these industries in the near future, except as the abundance of persimmon may result in expansion in the manufacture of shuttles and athletic goods, particularly golf club heads.

Use of Species

More than 15 percent of the present saw-timber volume is in species such as bitter pecan, cedar elm, and honeylocust, for which no appreciable market exists, regardless of quality. It is reasonable to expect that, as high-grade timber of the more marketable species becomes scarcer, bitter pecan will become more acceptable industrially much as the gums have during the past 25 years. The principal stands of bitter pecan have a high proportion of timber of a quality suitable for the production of industrial lumber. The most serious defect is a tendency to ring shake. A fair proportion of the volume of cedar elm is suitable for industrial use, and it seems likely that eventually this species may become a substitute for northern rock elm. Commercial use of much of the volume of this species will probably depend on the opportunity to market such commodities as cross ties, planking, and warehouse flooring.

In addition to the 15 percent of the volume referred to above, 45 percent of the present timber volume is in species that are not used at all by some forest industries and are discriminated against to some extent by others. Of these species, the water oaks, overcup oak, willow, white elm, hackberry, maple, sycamore, and boxelder are the most important. With the improvement of manufacturing methods, the water oaks and overcup oak should be adaptable to more varied industrial uses as well as to more extensive use in heavy structural work. Furthermore, the development of the small-dimension industry should make possible the profitable utilization of a class of timber of somewhat smaller size and lower grade. This should provide an outlet for a considerable part of the very large volume of overcup oak and water oaks that are not now suitable for industrial use because of marginal quality. With the further

development of the market for plywood and package materials, willow, white elm, hackberry, maple, sycamore, and boxelder should be used more extensively. In addition, willow, white elm, and sycamore have qualities that justify their wider use as industrial lumber. In the event of a widespread expansion of the fiberboard, paper, or hardwood distillation industries, there is available a large amount of suitable raw material not being otherwise used.

Employment

In general, owing to less complete manufacturing processes, small sawmills afford less employment than large sawmills for each M feet board measure of production; the production of common commercial and package veneers affords less employment per unit of timber used than face veneer; and production of slack staves and the lower grades of tight staves, less than the production of the higher grades of tight staves. Accordingly, the passing of some of the primary producing units, such as large sawmills, face-veneer plants, and high-grade tight-cooperage plants, is likely to reduce somewhat the average employment requirement per unit of timber used. On the other hand, the small-dimension industry and other secondary manufacturing industries afford much more employment per unit of timber used than the primary industries. Therefore, to the extent that the possibilities for small-dimension production and other secondary manufacture are realized, the above-mentioned loss in average employment per unit of timber consumed will be nullified. It consequently appears likely that the total industrial employment afforded per unit of timber volume consumed will either remain approximately constant or increase. The total requirement for labor will parallel the volume of manufactured forest products that results from general business trends. As forest management and utilization practices become more intensive, the forest-labor requirement will greatly increase. This woods labor will largely be needed to obtain adequate fire protection, as well as to make the thinning improvement cuttings needed to put the forest on a continuous production basis and provide intensive utilization of an increased yield. Also the character of the labor will change; the present full-time woods and mill worker will be supplemented in large part by farm and other part-time resident labor.

Action Needed

THE total cut of saw timber exceeds the increment of this class of material by more than 110 million board feet. Furthermore, the cut of the high-quality commercial-size saw timber necessary to maintain the present industries exceeds the increment of such timber to an even greater extent. It is apparent, therefore, that sooner or later the annual cut of saw timber will have to be materially reduced, at least temporarily, because of a lack of timber of the necessary size and quality. But since the present growing stock in its deteriorated condition is producing high-quality saw timber at a rate far below its capacity, the problem is to bring the increment of commercial saw timber and the requirements of industry gradually into balance at a level commensurate with the producing power of the forests of the unit. This problem is not as difficult as it may seem, since 20 percent of the forest area, or more than half a million acres, supported in 1934 commercial stands which are readily adaptable to management on a sustained-yield basis. This commercial forest area should be utilized and managed so that its production under a conservative-cutting policy will sustain the dependent forest industries at the highest practicable level, while the other 80 percent of the forest area now noncommercial is developing to the point where it can be cut conservatively.

The line of action to be recommended in the commercial forest, therefore, is largely one of conservative cutting, designed to make the most of the present growing stock in order to spread its use as far as possible over the time that must elapse until the younger timber has grown up, and to leave the cut-over areas in the best possible condition to produce an early and improved second cut. The line of action to follow in the 80 percent of the area that is noncommercial should be to increase

and improve the stand and to speed up its rate of growth in order that it may contribute its share to the requirements of industry as soon as possible and with as great and valuable a sustained annual increment as the site will allow.

Treatment of Commercial Forests

The objectives of management in commercial forests occupying 20 percent of the forest area are (1) to obtain through cutting the greatest returns per acre, while leaving an adequate basis for the production of early future cuttings; and (2) to build up and improve the residual growing stock so as to increase both the quality and volume of future harvests. These objectives can be reached, or at least approached, through the application of selective cutting and integrated logging. Selective cutting is a succession of partial cuttings in each of which part of the stand is removed and part is left to produce future cuts. An analysis of the saw-timber growing stock that exists at present on the average acre of commercial forest suggests a system of tree selection that will remove slightly more than 3,000 board feet, and leave the remainder (somewhat more than 4,000 board feet) for the production of future cuts to be made at 15-year intervals. Under such a cutting program in the present average commercial stand, the first cut would yield about 64 percent of its volume in trees at least 30 inches in diameter, 26 percent in trees 20 to 28 inches in diameter, and 10 percent in trees 14 to 18 inches in diameter. In general, the rate of diameter growth, the thrift, and the general tree form are the criteria for selecting trees to be cut. The trees upon which growth has been reduced to a minimum should be cut, if merchantable, regardless of size. In the 14- to 18-inch diameter

classes none but the slowest growing trees should be removed. In the 20- to 28-inch diameter classes, all trees of less than average growth rates should be cut; and in the 30- to 38-inch diameter classes, all trees should be cut except those showing the highest rates of growth. All trees 40 inches and larger should be harvested since they have usually reached their greatest value.

The volume of the average residual stand after such a harvest would be distributed approximately as follows: 11 percent in trees at least 30 inches in diameter, 58 percent in trees 20 to 28 inches in diameter, and 31 percent in trees 14 to 18 inches in diameter. According to available data on growth and mortality, it is estimated that, after one or two 15-year cutting periods of protection from fire and reasonably good management, the 4,000 feet left in residual stands can be expected to increase during a 15-year period to 9,000 board feet per acre. Thereafter cuttings which leave 4,000 board feet per acre can be expected at 15-year intervals.

In addition to improving growth in quantity, selective cuttings can also improve growth in quality. If in the first cut, the lower grades of timber are utilized to the fullest extent practicable, the percentage of volume in high-quality timber can be materially increased each time the area is harvested. It is reasonable to anticipate that within two cutting periods the proportion of material in high-quality logs can be increased by as much as 30 percent. The saw-timber cut should remove as high a proportion as feasible of the more poorly formed trees and trees of inferior quality or species. In addition to the saw timber, as many as possible of the suppressed trees below sawlog size and of the sound and rotten culls should be removed. The sooner these inferior and cull trees are out of the growing stock, the better. With the present quality requirements for hardwood lumber in the industries, the disposal of such low-grade material presents many difficulties, which, in fact, form the most substantial obstacle to management for sustained yield. Surmounting this obstacle involves the discovery of cheaper and more efficient methods of operation and the development of adequate markets for material from trees of poor quality, small size, or little-used species. Integrated logging for a group of industries whose timber requirements are complementary with respect to species, size, and quality is one of the most promising steps

toward the solution of the problem. Integrated logging is an operation that removes all the timber that it is proper to cut from a given area at one time and then sorts the material for the use to which its size, quality, and species best adapt it. This kind of logging is possible even now in some measure; with sufficient increase in markets for all classes of material it can be extended so as to realize fully the objectives of forest management.

There are, of course, several degrees of intensity in selective cuttings, and some owners, because of their heavy taxes or indebtedness, the unbalanced condition of their growing stock, the lack of balance between their timber supply and plant capacity, or because of other circumstances, may find it impracticable to proceed in accordance with the cutting policy outlined above and may wish to liquidate their timber investment. It has been demonstrated, however, that even in such cases it pays to choose carefully the trees to be felled and such owners will generally find it to their advantage to cut conservatively, leaving for further growth the smaller, rapid-growing trees and the larger trees of doubtful present value. Logging and milling studies carried on by the Forest Products Laboratory have shown that the indiscriminate cutting of trees of all sizes invariably produces both a hidden loss (owing to the excessive cost of handling small timber) and a low return (owing to the poorer average quality of the output). Another possible advantage accruing from conservative cutting is the increased value of the cut-over forest lands for timber growing; if there are prospects of immediate agricultural use, however, this advantage may be nullified.

Protection from periodic forest fires also is essential if the forest is to attain its highest producing capacity. The prevention of burning will check to a considerable extent at least, the present great losses in volume and grade due to rot, insects, and windfall. It will also favorably affect the rate of volume increment and will materially reduce the loss in small trees needed for the maintenance of the growing stock. Since there is no organized system of fire prevention in this unit, the State and Federal Governments cooperating under the Clark-McNary law should provide for this service.

Treatment of Noncommercial Areas

As has been shown, about 80 percent of the forest area in the unit is classified as noncommercial be-

cause of the immaturity of its growing stock, or because of the shortage of high-grade material in the stand. Parts of this area must have tree growth for several decades before they can be classified as commercial forest, though other parts are only a few years removed from such classification. On the other hand, extensive use of timber of lower quality, brought about either by changes in the manufacturing practices of existing industries or by the introduction of new industries, is all that is required to make still other areas commercial. The situation in the noncommercial area as a whole, therefore, requires the carrying of these stands for a period of years before they can be commercially utilized. Obviously, the growing stock on this 80 percent of the forest area is the basis from which the future timber supply of the unit must develop. Therefore, even though future changes in hardwood utilization practices may make possible harvest cuttings in these stands, the volume cut from them should be kept well below their growth until the growing stock is built up.

Any action that is taken to improve the density and growing conditions of these stands will be reflected in increased volume yield and improved quality of output. Two measures are particularly needful—protection from fire and removal of poor and surplus stems. A greater annual increment of high-quality material than is found under prevailing conditions will be brought about both by freedom from periodic burning in the growing stands, which are particularly susceptible to fire, and by removal from these stands of the many cull and surplus trees that occupy growing space or impede the development of the more valuable trees.

Some stands, even under present conditions, fully justify the expense involved in sanitation cuttings to remove the cull and defective trees, even though it may be impossible to recover the cost of the work through sale of material. Widespread application of sanitation measures, however, will probably depend upon the development of markets for the materials removed, so that receipts thus obtained will defray all or part of the cost of removal. The annual requirement for fuel wood and wood for domestic use from the forests of this unit is approximately 270,000 cords. At present, more than half of this is taken from the good growing stock. If all of this wood were taken from

the inferior and cull trees, the drain against present and potential saw-timber material would be decreased and a considerable forest area would be improved through sanitation cuttings. The introduction of the hardwood distillation and pulp industries would increase the outlet for such material.

General Recommendations

If the entire commercial forest area were given the full treatment recommended above, and if the entire noncommercial area were given the treatment necessary to bring it up to full producing capacity, it is possible that 50 to 60 years of such treatment would increase the annual increment in the north-Louisiana delta from its present 210 million board feet to about 800 million board feet, which is an approximate limit. That this limit ever will be actually attained is, of course, highly improbable. Its attainment would involve not only the revolutionizing of industrial practices and requirements but also the sustained uniform application of skillful forest management by approximately 10,000 landowners on holdings ranging from a few acres to more than a hundred thousand.

In this survey unit high land taxes, based to a considerable extent on speculative agricultural values, tend to discourage long-time private ownership and management of land for forest purposes. Where taxes are low or nominal, as on the batture or on large areas set aside for flood control, large-scale private ownership of forest land may be expected to continue. Elsewhere private ownership on a permanent basis is likely to persist mainly on a relatively small scale, incidental to plantations or other multiple-use land-management enterprises. Taxes on forest land must be not only reduced but also stabilized if the practice of forestry is to be encouraged on private timberlands. There are in this unit large areas which, because of their location in water-logged territory, are at the lower end of the scale of forest productivity and which will eventually be abandoned if taxes are not held to a minimum. The backwater areas tributary to the Red River in Concordia and Catahoula Parishes and the overflow areas in the Boeuf and La Fourche Basins are notable examples. These lands are already reverting to public ownership for nonpayment of taxes. Unless oil or some other subsurface

resource is developed, public agencies must look forward to carrying a large part of these lands permanently and should be prepared to supply such management as their potentialities justify.

Timberland owners in this section have had little, if any, experience in the raising of successive timber crops on their lands, and an intensive extension effort will be required to give them a general concept of the possibilities and opportunities of long-time forest management and an understanding of the technique involved. The State forest services and the Extension Service, with other cooperating Federal agencies, should greatly increase their educational and promotional activities. The trade associations of the major forest industries should employ foresters to work with and advise their members. In some instances large individual timberland owners can profitably engage the services of technical foresters.

Notwithstanding the importance of hardwoods in industry and the need of perpetuating and improving hardwood forests in the lower South, very little scientific research to this end has been carried on. Although sufficient knowledge is available to enable timber owners to inaugurate a program of improvement, much of the detailed information required for intensive hardwood-forest management must be developed through research in silviculture and economics. Studies to determine rates of timber growth, methods of logging and utilization, regulation of cut, and methods of stand improvement should be started without further delay. Demonstration areas illustrating the results of these studies should be established. Forest products research on a large scale also is needed in order that the present and prospective timber supply may be effectively utilized in industry.

Some form of cheap long-term financing is necessary in order to stabilize forest ownership, to facilitate continuity of management policy, to assist private timberland owners during the early stages of developing sustained yield, and to encourage the continued investment in growing stock thereafter.

To this end, measures such as the extension of the credit facilities of the Reconstruction Finance Corporation to industrial concerns and those of the Farm Credit Administration to farmers are suggested.

Growth calculations indicate that in 1934 both the board-foot and cubic-foot drain exceeded the corresponding growth; but, beyond this, all evidence points to the fact that both the quality and the quantity of the annual increment of the forest in this unit are considerably below its producing capacity. With selective cutting designed to conserve and improve the growing stock in the commercial area, with sanitation cuttings and good care of the huge area of noncommercial forest now in reserve for future cuts, and with widespread and effective protection from fire, the annual increment available for utilization can be doubled easily within two or three decades. Thus, an ultimate continuous timber production in excess of the 1934 cut is possible, even though the area devoted at present to the growth of timber may be somewhat reduced by an agricultural expansion, the extent and imminence of which cannot be estimated at this time. Present trends in industrial requirements for hardwood forest products indicate that the industries will be in a position to use the class of material which will be available when the present merchantable timber in this unit has been exhausted.

With its rich soil, abundant growing stock, and proximity to the center of wood consumption of the country, the north-Louisiana delta can continue to be a very important source of hardwood timber. Although the forest industries are at present poorly adjusted to the growing stock, this condition does not need to persist. Through wise handling of forest land, through adaptation of type of products manufactured to timber supply, and through adjustments in manufacturing and marketing practices, the forest industries in the unit can be put upon a permanent and expanding basis.

Appendix

TABLE 18.—Average acre stand and stock table, giving number of good trees and gross board-foot volume ¹ in important types, by diameter-class group and forest conditions

Forest type and diameter- class group	Old growth				Second growth					
	Uncut		Partly cut		Sawlog size				Under sawlog size	
					Uncut		Partly cut			
	<i>Trees</i>	<i>Board feet</i>	<i>Trees</i>	<i>Board feet</i>	<i>Trees</i>	<i>Board feet</i>	<i>Trees</i>	<i>Board feet</i>	<i>Trees</i>	<i>Board feet</i>
Red gum-water oak:										
2-4 inches	49.21		84.52		84.43		102.05		197.72	
6-12 inches	32.14		31.42		67.12	1	44.05		43.27	
14-18 inches	12.09	1,301	10.20	1,198	18.72	2,277	16.36	1,999	2.89	296
20-28 inches	9.70	3,423	6.35	2,206	5.80	1,895	4.67	1,514	1.05	328
30-38 inches	4.86	4,392	1.06	958	.51	391	.31	238	.18	153
40+ inches	1.41	2,598	.32	503	.08	104				
Total	109.41	11,714	133.87	4,865	176.66	4,668	167.44	3,751	245.11	777
Overcup oak-bitter pecan:										
2-4 inches	47.52		58.99		61.01		25.71		173.94	
6-12 inches	28.58		25.34		42.67		50.00		40.48	
14-18 inches	11.89	1,174	9.58	998	14.06	1,408	11.43	1,293	3.58	281
20-28 inches	8.78	2,521	6.29	1,792	4.28	1,121	3.43	899	1.52	476
30-38 inches	1.57	957	.75	461	.24	170			.30	212
40+ inches	.19	233	.06	53						
Total	98.53	4,885	101.01	3,304	122.26	2,699	90.57	2,192	219.82	969
Cottonwood-willow:										
2-4 inches					31.88		18.18		652.31	
6-12 inches					34.20		14.55		54.52	
14-18 inches					20.60	3,433	6.91	1,180	1.23	146
20-28 inches					12.39	5,617	4.36	1,812	.12	30
30-38 inches					.36	321	.73	795		
40+ inches							.36	1,257		
Total					99.43	9,371	45.09	5,044	708.18	176
Hackberry-elm-ash:										
2-4 inches	104.70		78.73		129.68		112.00		265.00	
6-12 inches	45.76		36.70	1	60.44		44.48		50.05	
14-18 inches	18.00	1,901	13.94	1,503	17.58	1,766	12.16	1,166	5.67	572
20-28 inches	8.65	2,482	4.67	1,338	4.09	1,118	1.92	598	1.11	332
30-38 inches	1.24	927	.42	295	.26	177			.06	44
40+ inches	.47	634	.02	20	.04	54				
Total	178.82	5,944	134.48	3,157	212.09	3,115	170.56	1,764	321.89	948
Average, 8 types:										
2-4 inches	53.73		65.28		76.17		69.96		260.93	
6-12 inches	30.77		29.55	2	53.68	18	43.32	27	48.39	13
14-18 inches	12.35	1,253	10.91	1,182	17.85	2,226	13.49	1,540	3.37	340
20-28 inches	9.07	2,750	5.91	1,764	6.57	2,321	3.46	1,089	.98	294
30-38 inches	2.25	1,700	.66	474	.36	274	.19	157	.16	118
40+ inches	.49	803	.10	128	.04	53	.02	60		
Total	108.66	6,506	112.41	3,550	154.67	4,892	130.44	2,873	313.83	765

¹ Scribner-rule volume of hardwood trees more than 13 inches in diameter; all board-foot volumes in the 6- to 12-inch diameter-class group are in 10- and 12-inch pines.

TABLE 19.—Average acre stand table, giving number and kind of cull trees per acre in important types, forest conditions, and by diameter-class group

Forest type and diameter- class group	Old growth				Second growth					
	Uncut		Partly cut		Sawlog size				Under sawlog size	
					Uncut		Partly cut			
	Sound cull	Rotten cull	Sound cull	Rotten cull	Sound cull	Rotten cull	Sound cull	Rotten cull	Sound cull	Rotten cull
Red gum-water oak:	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
2-4 inches	43.45	2.30	47.42	0.97	41.64	1.15	42.56		70.22	2.96
6-12 inches	9.84	1.55	12.62	2.84	12.74	1.70	9.39	2.10	13.39	1.16
14-18 inches	.75	.66	1.39	.97	1.54	.43	1.39	.72	1.50	.48
20-38 inches	.26	.58	.45	1.16	.39	.48	.46	.56	.48	.36
30-38 inches	.03	.55	.03	.19	.07	.13	.10	.21	.02	.18
40+ inches		.20	.03	.10		.11	.05			.09
Total	54.33	5.84	61.94	6.23	56.38	4.00	53.95	3.59	85.61	5.23
Overcup oak-bitter pecan:										
2-4 inches	48.08	1.92	34.56	.76	46.87	1.62	34.28		78.18	1.22
6-12 inches	10.25	1.18	12.13	1.05	14.22	2.87	14.86	3.72	11.76	.91
14-18 inches	2.09	.61	2.49	.90	2.14	.89	2.57	.86	2.67	.42
20-28 inches	.74	.92	.89	1.32	.57	.81		1.71	.48	.79
30-38 inches	.10	.66	.06	.59	.04	.44			.06	.42
40+ inches		.11		.10	.04					.12
Total	61.26	5.40	50.13	4.72	63.88	6.63	51.71	6.29	93.15	3.88
Cottonwood-willow:										
2-4 inches					30.08	.30	7.27		126.16	.62
6-12 inches					8.90	.55	10.19	.73	7.63	.93
14-18 inches					2.32	.81	1.45	.36	.49	.18
20-28 inches					.87	.45	1.09	.73	.43	.18
30-38 inches					.12	.06		.36		
40+ inches						.03				
Total					42.29	2.20	20.00	2.18	134.71	1.91
Hackberry-elm-ash:										
2-4 inches	46.47	2.35	34.95	1.09	58.46	4.40	35.20		65.94	2.78
6-12 inches	8.76	1.59	11.31	1.53	16.40	2.81	10.40	1.60	13.67	3.89
14-18 inches	1.59	.41	1.75	.72	2.02	.61	1.28	1.76	1.44	1.33
20-28 inches	.24	.24	.51	.62	.44	.53	.64	.48	.28	.28
30-38 inches	.12	.35	.02	.22	.09	.35		.32		.33
40+ inches				.04	.04	.09				
Total	57.18	4.94	48.54	4.22	77.45	8.79	47.52	4.16	81.33	8.61
Average, 8 types:										
2-4 inches	47.27	2.17	33.72	1.19	37.98	1.69	27.18	.35	69.71	1.85
6-12 inches	9.98	1.26	11.28	1.48	12.14	1.85	8.64	1.74	11.49	2.15
14-18 inches	1.77	.60	1.94	.93	1.70	.77	1.25	1.02	1.54	.69
20-28 inches	.58	.80	.68	1.14	.48	.66	.38	.62	.40	.52
30-38 inches	.09	.62	.05	.41	.06	.22	.05	.17	.02	.21
40+ inches		.13		.08	.01	.07	.02		.01	.05
Total	59.69	5.58	47.67	5.23	52.37	5.26	37.52	3.90	83.17	5.47

TABLE 20.—Commercial forest area in each forest condition and forest type

Forest type	Old growth ¹				Second-growth sawlog size ¹				Total commercial area ¹		Com- mercial forest area in each type
	Uncut		Partly cut		Uncut		Partly cut				
	<i>Acres</i>	<i>Percent</i>	<i>Acres</i>	<i>Percent</i>	<i>Acres</i>	<i>Percent</i>	<i>Acres</i>	<i>Percent</i>	<i>Acres</i>	<i>Percent</i>	<i>Percent</i>
Red gum-water oak.....	101,200	86.3	39,000	37.2	64,100	31.0	11,900	18.0	216,200	31.7	39.3
Hackberry-elm-ash.....	32,800	57.2	32,000	17.2	18,600	24.3	2,700	12.7	86,100	21.3	15.6
Overcup-bitter pecan.....	47,500	12.9	19,400	7.3	5,200	6.2	1,700	14.4	73,800	9.1	13.4
Cottonwood-willow.....					70,200	58.5	2,600	27.4	72,800	33.2	13.2
Cypress-tupelo.....	9,600	64.9	12,500	59.5	22,800	71.9	1,800	40.9	46,700	49.1	8.5
Water oak.....	6,700	41.1	5,900	8.0	14,400	30.0			27,000	13.9	4.9
Mixed oak-mixed hardwood.....	1,700	68.0	7,600	13.9	9,300	18.4	5,000	10.4	23,600	9.6	4.3
Pine-hardwood.....			800	47.1	2,500	22.9	900	15.3	4,200	14.7	.8
Total area of each condition that is in commercial area (percents weighted).....	199,500	34.5	117,200	16.5	207,100	33.0	26,600	13.6	550,400	² 20.5	-----
Commercial area in each forest condition.....		36.3		21.3		37.6		4.8			100.0

¹ Percents show the proportion of the given type and/or condition in the commercial area.² Percent of total forest area that is in commercial forest.TABLE 21.—Average acre stand and stock table for all types on commercial forest area, showing number of good trees and gross board-foot volume,¹ classified according to diameter-class group and forest condition

Diameter-class group	Old growth				Second-growth sawlog size			
	Uncut		Partly cut		Uncut		Partly cut	
	<i>Trees</i>	<i>Board feet</i>	<i>Trees</i>	<i>Board feet</i>	<i>Trees</i>	<i>Board feet</i>	<i>Trees</i>	<i>Board feet</i>
2-4 inches.....	56.44		72.75		54.40		82.58	
6-12 inches.....	34.29		41.30	2	50.83	14	35.87	21
14-18 inches.....	13.17	1,343	12.99	1,413	23.75	3,115	15.87	1,908
20-28 inches.....	10.78	3,509	10.06	3,258	11.92	4,606	6.71	2,306
30-38 inches.....	4.05	3,449	1.51	1,282	.64	539	.39	388
40+ inches.....	1.17	2,082	.29	445	.12	144	.13	446
Total.....	119.90	10,383	138.90	6,400	141.66	8,418	141.55	5,069

¹ Scribner-rule volume of hardwood trees more than 13 inches in diameter; all the board-foot volumes in the 6- to 12-inch diameter-class group are in 10- and 12-inch pines.

TABLE 22.—Average acre stand table for all types on commercial forest area, showing number of cull trees per acre, classified according to diameter-class group, forest condition, and kind of cull

Forest condition and kind of cull	2-4 inches	6-12 inches	14-18 inches	20-28 inches	30-38 inches	40+ inches	All diameters
Old growth:							
Uncut:	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Sound.....	41.18	9.61	1.14	0.34	0.05		52.32
Rotten.....	2.38	1.32	.49	.56	.51	0.15	5.41
Partly cut:							
Sound.....	34.49	19.45	1.33	.64	.03		55.94
Rotten.....	2.60	1.45	.78	.93	.35	.12	6.23
Second-growth sawlog size:							
Uncut:							
Sound.....	28.81	11.22	1.07	.41	.05	.02	41.58
Rotten.....	1.19	1.59	.97	.71	.20	.03	4.69
Partly cut:							
Sound.....	51.61	10.58	1.16	.52	.13	.13	64.13
Rotten.....		2.58	.39	.51	.13		3.61

TABLE 23.—Forest area in each of several forest conditions classified according to density of reproduction

Forest condition	Adequate stocking ¹	Intermediate stocking ²	Sparse stocking ³
	Percent	Percent	Percent
All sawlog size.....	18.0	23.0	59.0
Under sawlog-size second growth.....	32.0	23.0	45.0
Reproduction.....	66.0	34.0	.....
Clear-cut.....	.....	.....	100.0
Nonproductive.....	.....	4.0	96.0

¹ Areas of adequate reproduction support a seedling stand of commercial species of sufficient density to develop a new hardwood stand capable of producing saw timber.

² Areas of intermediate reproduction support a seedling stand of commercial species of sufficient density to supplement adequately the partial overstory characteristic of cut-over delta hardwood stands.

³ Sparsely reproducing areas have either no seedlings of commercial species or too few seedlings to supplement adequately the partial overstory.

TABLE 24.—Forest area in each forest type proportioned according to degree of fire damage

Forest type	No indication of fire	Degree of fire damage ¹			
		None	Light	Medium	Heavy
	Percent	Percent	Percent	Percent	Percent
Red gum-water oak.....	14.2	23.4	27.3	19.8	15.3
Hackberry-elm-ash.....	8.6	24.5	31.0	24.5	11.4
Overcup oak-bitter pecan.....	21.1	36.9	23.1	12.7	6.2
Cottonwood-willow.....	81.6	12.4	4.1	1.4	.5
Cypress-tupelo.....	32.0	44.3	13.4	10.3	.....
Water oak.....	6.5	24.7	38.5	17.3	13.0
Mixed oak-mixed hardwood.....	12.0	24.7	30.6	20.3	12.4
Pine-hardwood.....	17.6	17.6	32.4	11.8	20.6
All types.....	20.0	27.7	25.7	16.6	10.0

¹ Field men classified fire damage subjectively on the basis of number of trees injured and extent of injury.

TABLE 25.—Net board-foot (Scribner, Doyle, and International rules) and cubic-foot volumes of good trees of all species groups

Species group	Board-foot volume ¹			Cubic-foot volume excluding bark ²	
	Scribner rule	Doyle rule	International ¼-inch rule	Sawlog-size trees	Under sawlog-size trees
	<i>M board feet</i>	<i>M board feet</i>	<i>M board feet</i>	<i>M cubic feet</i>	<i>M cubic feet</i>
Red gum.....	1,352,400	1,179,600	1,479,100	235,920	84,620
Water oaks.....	1,721,300	1,549,900	1,878,700	304,510	55,630
Red oaks.....	42,500	35,200	48,200	8,150	7,100
White oaks.....	99,200	81,700	110,000	18,480	12,070
Overcup oak.....	1,486,400	1,316,300	1,629,200	292,930	42,830
Ash.....	346,200	253,200	381,900	80,690	65,250
Cottonwood.....	529,900	446,600	577,500	90,260	14,940
Willow.....	580,100	474,700	650,100	111,110	23,630
Elms ³	692,100	564,200	767,700	133,210	77,460
Tupelo gum ⁴	228,900	183,900	256,500	47,150	7,900
Cypress.....	251,700	195,000	256,200	47,850	7,780
Bitter pecan.....	1,047,000	871,900	1,173,000	220,060	69,560
Sweet pecan ⁵	176,100	146,100	200,600	32,980	19,780
Hackberry.....	298,700	228,400	337,900	61,180	64,390
Pines.....	39,200	25,300	42,600	7,680	4,970
Miscellaneous ⁶	270,700	224,400	302,200	52,260	57,630
Total.....	9,162,400	7,776,400	10,091,400	1,744,420	615,540

¹ Both woods cull and mill cull are removed from board-foot volumes, but only woods cull is removed from cubic-foot volumes.

² Cubic-foot volume of trees under sawlog size includes the wood of the main stem from stump to a usable top. The minimum allowable top was never less than 4 inches and seldom more than 8. The cubic volume of sawlog-size trees includes the volume to a merchantable top for saw timber and does not include top wood or limb wood.

³ Of the total elm volume, approximately 51 percent is cedar elm, 42 percent white elm, and 7 percent winged and red elm.

⁴ Approximately ⅓ of this volume is black gum.

⁵ Approximately 23 percent of this volume is hickory.

⁶ The volume of persimmon included here has been expressed in cubic feet only, even though some trees were more than 13 inches in diameter.

Scientific Names of Species Mentioned in Text

The common names used in the text are in some instances trade names; in such cases the common name accepted by the Forest Service follows in parentheses.

Ash, green	<i>Fraxinus pennsylvanica lanceolata</i> (Borkh.) Sarg.	Honeylocust	<i>Gleditsia triacanthos</i> L.
Ash, white	<i>F. americana</i> L.	Maple, red	<i>Acer rubrum</i> L. and/or <i>Acer rubrum drummondii</i> (Hook. and Arn.) Sarg.
Boxelder	<i>Acer negundo</i> L.	Mulberry, red	<i>Morus rubra</i> L.
Buttonbush	<i>Cephalanthus occidentalis</i> L.	Oak, black	<i>Quercus velutina</i> LaM.
Cottonwood	<i>Populus deltoides virginiana</i> (Castigl.) Sudw. ⁹	Oak, bottom-land red	<i>Q. nuttallii</i> Palmer.
Cypress, southern	<i>Taxodium distichum</i> (L.) Rich.	Oak, cherrybark (swamp red)	<i>Q. rubra pagodaefolia</i> (Ell.) Ashe.
Elm, cedar	<i>Ulmus crassifolia</i> Nutt.	Oak, cow (swamp chest-nut)	<i>Q. prinus</i> L.
Elm, red (slippery)	<i>U. fulva</i> Mich.	Oak, delta post	<i>Q. mississippiensis</i> (Ell.) Ashe.
Elm, rock	<i>U. racemosa</i> Thom.	Oak, forked-leaf white (white)	<i>Q. alba</i> L.
Elm, white (American)	<i>U. americana</i> L.	Oak, overcup	<i>Q. lyrata</i> Walt.
Elm, winged	<i>U. alata</i> Mich.	Oak, southern red	<i>Q. rubra</i> L.
Gum, black	<i>Nyssa sylvatica</i> Marsh.	Oak, water	<i>Q. nigra</i> L.
Gum, red	<i>Liquidambar styraciflua</i> L.	Oak, willow	<i>Q. phellos</i> L.
Gum, tupelo	<i>Nyssa aquatica</i> L.	Pecan, bitter (water hick-ory)	<i>Hicoria aquatica</i> (Mich.) Britt.
Hackberry (sugarberry)	<i>Celtis laevigata</i> Willd.	Pecan, sweet (pecan)	<i>H. pecan</i> (Marsh.) Britt.
Hickory (any or all of the following species):		Persimmon	<i>Diospyros virginiana</i> L.
Bitternut	<i>Hicoria cordiformis</i> (Wang.) Britt.	Pine, loblolly	<i>Pinus taeda</i> L.
Shagbark	<i>H. ovata</i> (Miller) Britt.	Planer tree	<i>Planera aquatica</i> (Walt.) Gmel.
Bigleaf shagbark	<i>H. laciniosa</i> (Mich. f.) Sarg.	Privet (swamp)	<i>Forestiera acuminata</i> (Mich.) Poir.
Mockernut	<i>H. alba</i> (L.) Britt.	Sycamore	<i>Platanus occidentalis</i> L.
Pignut	<i>H. leiodermis</i> (Sarg.) Sudw.	Waterlocust	<i>Gleditsia aquatica</i> Marsh.
		Willow (black)	<i>Salix nigra</i> Marsh. (principally).

⁹ Except in swamps where swamp cottonwood (*P. heterophylla* L.) is found.

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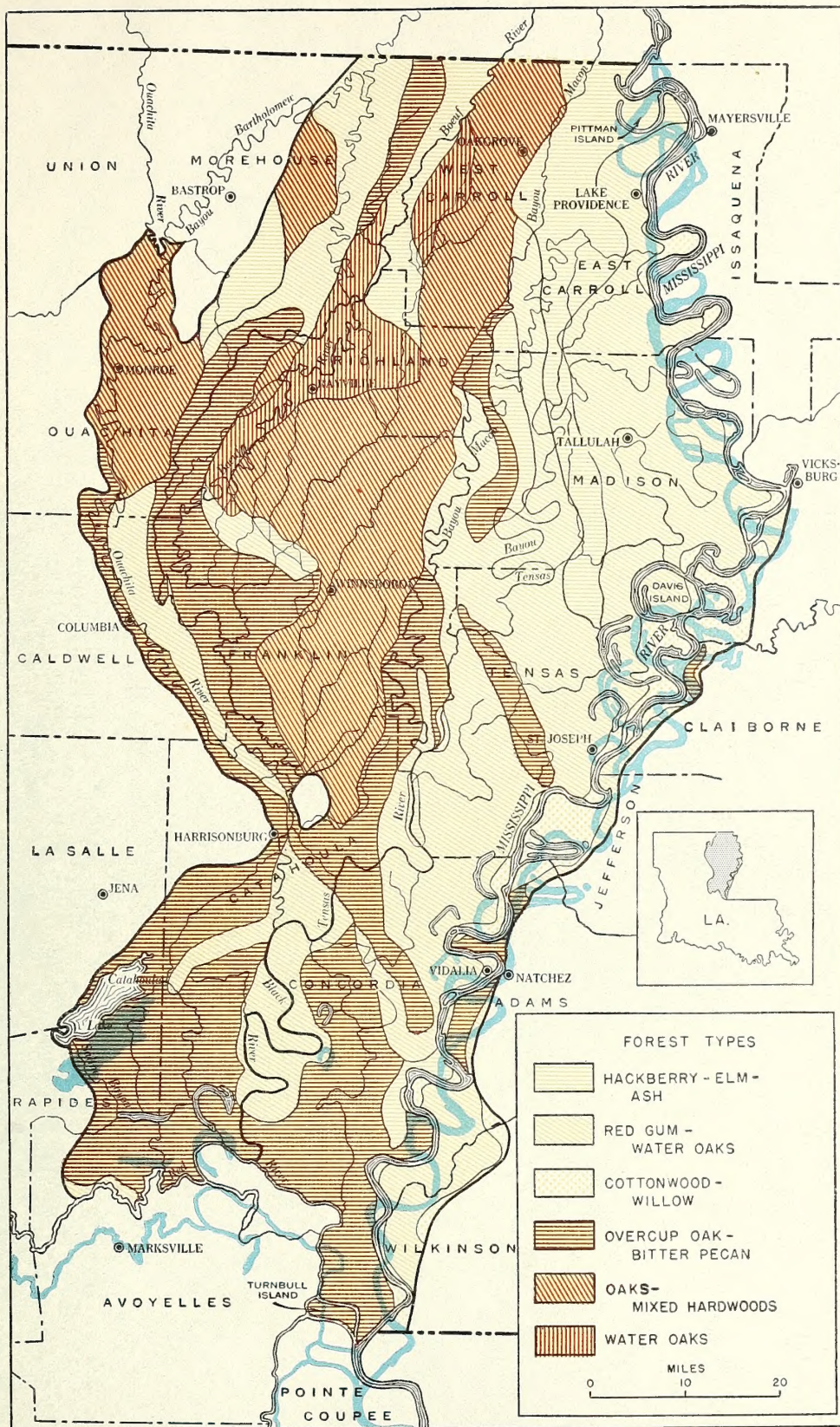


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